THE AMERICAN SPECIES OF SNAPPING SHRIMPS OF THE GENUS SYNALPHEUS.[a]

By Henri Coutière,
Of the Ecole Supérieure de Pharmacie, Paris.

HISTORY OF THE AMERICAN SPECIES OF THE GENUS.

The nominal species of *Synalpheus* from the coasts of America at the present time are eight in number, of which one, *Alpheus precox* of Herrick, is a *nomen nudum*. All of them appeared at first under the generic name of *Alpheus: A. minus* Say (1818), *A. spinifrons* Milne Edwards (1837), *A. tridentulatus* Dana (1852), *A. saulcyi* Guérin (1856), *A. leviusculus* Lockington (1878), *A. saulcyi longicarpus* and *A. saulcyi brevicarpus* Herrick (1891).

These nominal species are so imperfectly diagnosed that I have been able to retain the names of only three of them, *Synalpheus minus* (Say), *S. brevicarpus* (Herrick), and *S. longicarpus* (Herrick). This list could have been augmented by *Alpheus leviusculus* Lockington, had it not been necessary to change the name (it having been preoccupied by Dana) to *S. lockingtoni*.

The *A. spinifrons* of Milne Edwards is from Chile. The type is lost, and I have seen no form from that region which exactly corresponds. Although Nicolet's drawing may be very imperfect with regard to the cephalic appendages, yet the scaphocerite seems to be much reduced, and this is confirmed by the text: "lámina basilar de las antenas esternas muy pegueña, sin llegar con mucho á la estremidad del pedúnculo de estos órganos." I do not believe that the species, in view of this circumstance, can be placed elsewhere than in the Lævimanus group. The small claw, it is true, is described simply "con algunas pelos," but the plume of long hairs, so characteristic of this claw in the group, could, in spite of its constancy, very easily pass unnoticed. This plume has never before been described or figured; but the unusual prevalence of the Lævimanus group on the American coasts compels me to recognize the importance of this curious, though apparently insignificant, character.

Formerly, I identified *Alpheus tridentulatus* Dana with *A. minus* Say, by reason of the short and broad form of the frontal teeth and

[a] Translated from the French by Miss Mary J. Rathbun.

Proceedings U. S. National Museum, Vol. XXXVI—No. 1659.
Proc. N. M. vol. xxxvi—09——1

the slight build of the small claw. Dana's species is from Rio Janeiro, and the species of the BREVICARPUS group (to which *A. minus* belongs) are not as yet known to extend beyond Bahia. But that is a purely negative assumption, of very little value, and I still, as the most plausible explanation, consider that the antennal scale was accidentally omitted from Dana's drawing. The absence of this scale would suggest the LÆVIMANUS group; but none of the species of this group have the external spine of the basicerite so short or the stylocerite so long. The exact identification of the form is, however, impossible because of the large number of closely related species and the slightness of the distinctive characters.

Alpheus minus is no longer represented by authentic specimens, except the two dried examples, fortunately alike, preserved in the British Museum and sent to Doctor Leach by Thomas Say himself. They can be identified with a rather common species from Florida and the Bahamas; such a determination would probably not be possible for all the specimens collected by Say, did they still exist. Another species from the same region, appearing to be even more common, is that which Herrick has described under the name of *A. saulcyi brevicarpus*, in opposition to his *A. saulcyi longicarpus*. Far from being closely allied varieties of a single species, these two forms are in reality widely separated and easily distinguished; furthermore, *S. brevicarpus*, which I had formerly considered synonymous with *S. minus* (Say), is also distinct, and each of these two species possesses several subspecies, forming a small, well-defined group which may be designated as the BREVICARPUS group, which, so far as is known at present, is characteristic of the American region.

I have not succeeded in identifying *Alpheus saulcyi* Guérin with any of the forms which I have studied; the species belongs obviously to the BREVICARPUS group, being perhaps synonymous with *S. brevicarpus* (Herrick). In Guérin's drawing the chief character which recalls this species is the narrow form of the antennules; but the frontal teeth, the scaphocerite, the superior prominence of the basicerite are very imperfectly figured. As Guérin's species is from Cuba, I should be more inclined to believe it synonymous with the new form which I have named *S. brevicarpus guerini*, which is also from the West Indies, and which in other respects appears most comparable to Guérin's figure. This resemblance is, however, much too vague for me to consider myself justified in retaining the name of *saulcyi*, in spite of my desire to do so.

As to *Alpheus longicarpus*, I have been able to examine two specimens received from Professor Herrick; because of the dissimilarity of these two specimens, I had thought it wisest to distinguish all those which corresponded to them respectively under the name of *longicarpus* α and β, but this distinction is very far from being satisfactory; for

S. longicarpus α belongs in reality to the group which I call the LÆVIMANUS group, from the name of the Mediterranean species of Heller, a group which is characterized essentially by a brush of long stiff hairs on the movable finger of the small claw. I have been obliged to recognize eighteen species and subspecies belonging to it upon the American coast, so that the old specific limits have become greatly narrowed; I have retained the name *longicarpus* for that species which appears to be among the most widely distributed in the region of the Gulf of Mexico and the Bahamas, and which conforms to one of Herrick's types; the species has small eggs and its larvæ are zoëæ; in regard to *S. longicarpus* β, the specimens which I had at first grouped under that name are found to be referable to three very distinct species, each provided with numerous subspecies; that species which corresponds to the type specimen of Herrick is *S. pectiniger*, new species; the other two have received the names *S. brooksi* and *S. herricki*. All three have eggs of large size, from which spring mysis larvæ, and one of the species must certainly be Herrick's nominal species *Alpheus precox*, without its being possible to definitely determine which.

Save for the preceding exceptions, all the forms, perhaps thirty species and varieties, have had to receive new names. It is a considerable number, and surprised me at first. Although several present very strong resemblances to other forms of the eastern Atlantic, the Indian Ocean, and the Pacific islands, all are peculiar to the American coasts. This is true also of *S. lockingtoni*, which is represented in the Indian Ocean by some closely allied species, which, in turn, are difficult to separate from specimens from the Red Sea, the Mascarene Islands, and from the west coast of Africa. It would seem that these specimens represent local races of a cosmopolitan species. There is, however, a remarkable exception in *S. latastei*, Chilian specimens of which can not be distinguished from Australian.

CLASSIFICATION OF THE SPECIES.

In view of the growing number of species of the genus *Synalpheus*, one is led to distinguish among them several groups composed of the more closely allied forms, which may be differentiated in the following manner:

KEY TO THE SPECIFIC GROUPS OF THE GENUS SYNALPHEUS.

a^1. Supraorbital spines insignificant compared to the rostrum; antennules shorter than the antennæ; spines of the basicerite almost equal, the external always smaller than the stylocerite; external maxillipeds oval, feebly spinous distally; first segment of the carpus of the second pair of feet very long; following feet cylindrical; ventral hook of the dactyl obsolete; telson with an oval median lobe.....COMATULARUM group.

a^2. Supraorbital spines at least equal to the rostrum in importance; antennules at least equal to the antennæ; spines of the basicerite unequal, the exter-

nal often larger than the stylocerite, the internal often wanting; external maxillipeds cylindrical in form, very spinous distally; first segment of the carpus of the second pair approximately equal to the sum of the remaining segments; following feet flat in the sagittal plane; ventral hook of the dactyl as large as the dorsal; posterior border of the telson almost straight.

b^1. Dactyls of the third, fourth, and fifth feet with two unequal hooks, the ventral always stronger (up to three times greater), often accompanied by a third prominence obtuse or spinous; meropodites often spinous; frontal spines always longer than wide at the base_____Neomeris group.

b^2. Dactyls with two hooks approximately equal in width at the base; meropodites smooth.

c^1. Dactyls long and slender; hooks directed with the axis of the dactyl, little curved, the dorsal longer; scale of the scaphocerite always present; lateral spine of the basicerite slender; stylocerite longer than the basal article of the antennulæ.

d^1. Frontal teeth always longer than wide and spinous; rostrum armed with a vertical prolongation which embraces the ocellary beak. Paulsoni group.

d^2. Frontal teeth squarish, at most with concave margins; rostrum without inferior vertical prolongation_____Brevicarpus group.

c^2. Dactyls short; hooks strongly curved, the ventral directed normal to the lower border of the dactyl; scale of the scaphocerite ordinarily much reduced, often wanting; lateral spine of the basicerite always longer than the basal article of the antennulæ, thick; stylocerite short.

d^1. Small claw with a brush of thick and crowded long hairs normal to the dactyl; stylocerite at most equal to the basal article of the antennule; carpus of the small cheliped longer than wide. Lævimanus group.

d^2. Small claw without a brush of hairs; stylocerite not reaching the middle of the median article of the antennule; antennal scale narrow, not reaching beyond the extremity of the same article; carpus of the small cheliped short_____Biunguiculatus group.

The Comatularum group is differentiated from the other groups by some very marked characters, which are almost all characters found in the Hippolytidæ and therefore suggest a less strong resemblance to the "Reptantia;" as frequently happens, there are added to these primitive characters others which show, on the contrary, an adaptation carried very far; for instance, the strongly curved hooks and the movable finger of the small chela surpassing the fixed finger; these characters are especially marked in *S. comatularum*, and are explained by its commensalism with the Comatulida, being implements of attachment for the *Synalpheus*.

This group of very beautiful species appears not to occur on the American coast; the steamer *Albatross*, of the U. S. Bureau of Fisheries, has collected a new species of it at the Gilbert Islands, the more remarkable because it possesses only a few of the unusual characters of the group: The spines of the basicerite are equal and short, the first segment of the carpus of the second pair very long, and the following feet cylindrical. On the other hand, the antennules are equal to the antennæ, the rostrum is scarcely more prominent than the

lateral teeth, the ventral hook of the dactyls is almost as strong as the dorsal, and the telson is straight along its posterior margin—all characters not unusual in *Synalpheus*. The other groups of species vary more or less from the preceding; the nearest are the PAULSONI and BREVICARPUS groups, in which the stylocerite still remains more prominent than the external spine of the basicerite, and the antennal scale is never wanting and sometimes is very wide.

The external spine of the basicerite begins to predominate in the NEOMERIS group, but this group presents, besides, two characters of the Hippolytidæ but little modified, viz, the movable spines often present on the third and fourth meropodites and the frequent triunguiculation of the dactyls of the same feet, which is a vestige of the series of spines present on the dactyl in many of the Eucyphota.

There are no more than two hooks on the short and stocky dactyl in the BIUNGUICULATUS group, of which the ventral, the more feeble, has a tendency to become normal to the lower border of the dactyl. On the other hand, the shortening of the stylocerite and of the antennal scale becomes very noticeable and the finger of the small chela of the second pair carries a brush of hairs arranged in series. The species grouped under this head are few, but they show the very gradual connection between those which precede and the LÆVIMANUS group, the most highly differentiated of the Synalpheids in the direction of the "Reptantia." Here the antennal scale has very often disappeared without leaving any trace, the lateral spine of the basicerite possesses a bulk which contrasts with the slight importance of the stylocerite, and the sexual differences often become very strong, one might say exaggerated, in regard to the size of the abdomen of the female and of the large cheliped of the male; finally, the finger of the small cheliped, in which the carpus has, however, remained more elongated than in any other group, bears a curious structure composed of from fifteen to twenty transverse rows of long stiff hairs, which are normal to the dactyl, and which diminishes in length from behind forward; this brush may be a cleansing organ in connection with the very sedentary life of these species, or it may conceal from the prey the extremity of the real prehensile chela. The only comparable organ in the Alpheidæ is the tuft of long plumose hairs which is borne by the chela of the second pair in *Cheirothrix parvimanus* Bate, a genus, moreover, very like *Synalpheus*.

KEY TO THE SPECIES AND SUBSPECIES OF THE GENUS SYNALPHEUS.

NEOMERIS group.

(Represented on the American coast only by forms with the meropodites smooth and unarmed.)

a^1. Ventral supernumerary prominence of the third, fourth, and fifth dactyls obtuse and scarcely marked.

b^1. All the appendages slender.

c^1. Meropodites of the third pair four times as long as wide.

d^1. Antennal spine equaling the carpocerite——*S. fritzmülleri.*

d^2. Antennal spine surpassing the carpocerite——*S. fritzmülleri elongatus.*

c^2. Meropodites of the third pair three times as long as wide——*S. nobilii.*

b^2. All the appendages stocky; meropodite of the third pair only 2.5 times as long as wide——*S. sanlucasi.*

a^2. Ventral supernumerary prominence of the third, fourth, and fifth dactyls spinous and very marked.

b^1. Antennary spine equaling the carpocerite——*S. hemphilli.*

b^2. Antennary spine surpassing the carpocerite; traces of spines on the meropodites of the third pair——*S. hemphilli longicornis.*

PAULSONI group.

a^1. Carpocerite long, arising opposite the separation of the stylocerite from the basal article of the antennulæ; meropodite of the third pair from 3.5 to 5 times as long as wide.

b^1. Basicerite unarmed above, carpocerite 3.5 times as long as wide.

c^1. Palmar prominence spinous; angles of the telson sharp, the inner spines of its posterior border 3 times longer than the outer spines.

d^1. Rostrum at most equal to the basal article of the antennulæ; antennary spine not surpassing the carpocerite——*S. townsendi.*

d^2. Rostrum, frontal, and antennal spines more elongate.

S. townsendi productus.

c^2. Palmar prominence obtuse; angles of the telson right, the inner spines only twice the length of the outer——*S. townsendi brevispinis.*

b^2. Basicerite with a right and not obtuse superior angle; posterior angles of the telson very sharp——*S. townsendi mexicanus.*

b^3. Basicerite strongly spinous above; carpocerite ovoid, three times as long as wide.

c^1. Meropodite of the third pair less than four times as long as wide.

d^1. Dactyl of the third pair about 3.2 times as long as wide at the base.

c^1. Carpus of the small cheliped spinous above; spine of the scaphocerite equal to the carpocerite——*S. apioceros.*

c^2. Carpus of the small cheliped not spinous above; spine of the scaphocerite shorter than the carpocerite——*S. apioceros sanjosei.*

d^2. Dactyl of the third pair 3.8 times as long as wide; carpocerite very swollen, surpassing the antennule by 1.5 times its distal article; spine of the large claw continuing in a straight line its superior border——*S. apioceros mayaguensis.*

c^2. Meropodite of the third pair more than four times as long as wide.

d^1. Antennal spine longer than the antennule; rostro-orbital interval acute at base; spine of the large claw preceded by a tubercle.

S. apioceros leiopes.

d^2. Antennal spine at most equal to the antennule, rostro-orbital interval broad and sinuous at base; spine of the large claw continuing the superior border in a straight line——*S. apioceros desterroensis.*

a[2]. Carpocerite short, arising nearly opposite the median antennulary article; basal article of the antennule equal to the following, or 1.5 times as long, or more; palmar border of the large cheliped unarmed.

b[1]. Carpocerite three times as long as wide.

c[1]. Meropodite of the third pair more than 3.5 times as long as wide; large chela 2.9 times as long as high; antennal spine equal to the carpocerite ..... *S. lockingtoni.*

c[2]. Meropodite of the third pair less than 3.5 times as long as wide; large chela 2.5 times as long as high; antennal spine longer than the carpocerite, slender ..... *S. latastei tenuispina.*

b[2]. Carpocerite less than three times as long as wide; antennule thick, scarcely four times as long as wide; meropodite of the third pair three times as long as wide ..... *S. latastei.*

b[3]. Carpocerite more than three times as long as wide; meropodite slender, five times as long as wide; spine of the scaphocerite surpassing the antennule ..... *S. paulsonoides.*

BREVICARPUS group.

a[1]. Carpocerite cylindrical, slender, at least four times as long as wide; antennal scale from 5.5 to 6.4 times as long as wide; basicerite almost unarmed above; meropodite of the third pair from 4.25 to 4.5 times as long as wide; carpus of the second pair from ten to fifteen times as long as wide; telson 2 to 2.2 times as long as wide distally.

b[1]. Lateral spine of the scaphocerite scarcely surpassing the scale; frontal teeth equilateral, short; eggs of large size, producing mysis. *S. brevicarpus.*

b[2]. Lateral spine of the scaphocerite long and slender; frontal teeth as long as wide at the base; rostrum with concave margins; eggs small, producing zoëæ ..... *S. brevicarpus guerini.*

a[2]. Carpocerite swollen, from 3.5 to 3.7 times as long as wide; antennal scale from 7 to 8.5 times as long as wide; carpus of the second pair less than ten times as long as wide; meropodite of the third pair 3.4 to 4 times as long as wide; telson 1.8 times as long as wide distally; larvæ zoëæ.

b[1]. Antennules at most five times as long as wide; rostrum as long as the lateral teeth of the front.

c[1]. Frontal teeth short, equilateral.

d[1]. Superior spine of the basicerite feeble, as wide as long, that of the scaphocerite shorter than the carpocerite; small claw with elongated fingers, 2.8 times longer than wide ..... *S. minus.*

d[2]. Superior spine of the basicerite twice as long as wide, that of the scaphocerite equal to the carpocerite; small claw with short fingers, 2.6 times as long as wide ..... *S. minus bahiensis.*

c[2]. Frontal teeth long, a little concave; carpocerite very swollen, from 3.2 to 3.5 times as long as wide; scaphocerite short; hooks of the dactyls often equal ..... *S. minus antillensis.*

b[2]. Antennules more than five times as long as wide; rostrum shorter and narrower than the lateral teeth.

c[1]. Carpocerite 3.5 times, meropodite of the third pair 3.4 times, as long as wide ..... *S. digueti.*

c[2]. Carpocerite 3.2 times, meropodite 3.25 times, as long as wide. *S. digueti ecuadorensis.*

LÆVIMANUS group.

a^1. Carpus of the small cheliped measuring always more than one-half of the chela in the adult (proportion included between 0.54 and 0.8, but may be reduced to 0.5 in the young).

b^1. Lateral spine of the basicerite smaller than that of the scaphocerite.

c^1. Fingers of the small chela each armed with three strong flat teeth, crossed in a vertical plane; no trace of antennal scale; spine of the scaphocerite shorter than the antennule; movable finger of the chela out of the perpendicular; eggs of large size ..... *S. pectiniger.*

c^2. Fingers of the small chela with only two teeth; spine of the scaphocerite equaling the antennule.

d^1. A trace of an antennal scale in the male; carpus of the small cheliped reaches 0.74 of the chela, diminishing to 0.5 and even a little less in the young ..... *S. longicarpus.*

d^2. An antennal scale in both sexes; carpus of the small cheliped not exceeding 0.54 in the adult males ..... *S. longicarpus approxima.*

b^2. Lateral spine of the basicerite equal to that of the scaphocerite, but both shorter than the antennule; antennal scale totally absent.

c^1. Carpus measuring from 0.67 to 0.8 of the small chela.

d^1. Proportion of T. L.: H.[a]=2.6:1 to 2.5:1; meropodite of the small cheliped 3 to 3.3 times as long as wide ..... *S. herricki.*

d^2. Proportion of T. L.: H.=2.7:1, the chela being more slender; meropodite of the small cheliped four times as long as wide. *S. herricki dimidiatus.*

c^2. Carpus measuring 0.65 of the small chela; proportion of T. L.: H.=3:1 ..... *S. herricki angustipes.*

c^3. Carpus measuring 0.56 of the small chela, proportion of T. L.: H.=3.2:1; carpocerite 5.4 times longer than wide (instead of 4.8 to 5); feet of second and third pairs one-fourth stronger than in the preceding forms ..... *S. tanneri.*

a^2. Carpus measuring about one-half of the small chela in the adult (0.45 to 0.52).

b^1. A well developed antennal scale in both sexes; carpocerite 6.5 times longer than wide; meropodite of the third pair 3.8 times longer than wide; small chela slender, proportion of T. L.: H.=3.33:1.

c^1. Spine of the basicerite and of the scaphocerite shorter than the antennule ..... *S. pandionis.*

c^2. Spines equal to the antennule ..... *S. pandionis extentus.*

b^2. No antennal spine.

c^1. Basicerite spinous above; carpus of the second pair with four segments ..... *S. rathbunæ.*

c^2. Basicerite unarmed above.

d^1. Large chela 2.5 times longer than wide, its anterior palmar spine directed obliquely downward; supraorbital spines wide, leaving between them and the rostrum U-shaped intervals; carpocerite 5.5 times longer than wide; meropodites of the third pair thick (proportion 3.3:1); eggs small; larvæ zoëæ ..... *S. grampusi.*

d^2. Large chela 2.7 to 3.25 times longer than wide; anterior palmar spine conical, directed obliquely upward; supraorbital spines obtuse, divergent; meropodite of the third pair slender (proportion 4.3:1 to 4.5:1); eggs of large size; larvæ mysis.

[a] Total length to height (of large chela).

c^1. Carpus of the small cheliped measuring 0.5 of the chela.
f^1. Carpocerite 4.5 times as long as wide ..... *S. brooksi.*
f^2. Carpocerite 5.5 times as long as wide ..... *S. brooksi strepsiceros.*
e^2. Carpus of the small cheliped measuring 0.53 to 0.57 of the chela; carpocerite 4.4 times as long as wide ..... *S. brooksi eleuthera.*
a^3. Carpus measuring less than 0.5 of the small chela (0.43 to 0.4).
b^1. Meropodite and carpus of the third pair excavate, with a transparent outer margin ..... *S. androsi.*
b^2. Meropodite of the third pair not excavate; carpus shorter than the propodite.
c^1. Brush of hairs of the small chela very reduced (about 30 hairs in 6 rows); antennal scale present in the male only ..... *S. paraneptunus.*
c^2. Brush of hairs of large size, composed of 15 to 20 rows.
d^1. Carpocerite 3.5 to 4 times longer than wide; meropodite of the third pair 4 to 4.5 times longer than wide ..... *S. sanctithomæ.*
d^2. Carpocerite 5.2 to 6 times, meropodite 3 to 3.5 times, longer than wide.
e^1. Antennal scale present in both sexes ..... *S. goodei.*
e^2. Antennal scale absent (or extremely narrow when it is exceptionally present) ..... *S. goodei occidentalis.*

DISTRIBUTION AND DISCUSSION OF SPECIFIC CHARACTERS.

Table of distribution of the species of the genus Synalpheus.

COMATULARUM GROUP.

Indo-Pacific forms.	American forms.	Mediterranean and West African forms.
S. comatularum Haswell.		
S. stimpsoni de Man.		
S. stimpsoni maldivensis Coutière.		
S. carinatus de Man.		
S. amboinæ Zehntner.		
S. albatrossi Coutière.		

NEOMERIS GROUP.

S. neomeris de Man.		
S. neomeris streptodactylus Coutière.		
S. nilandensis Coutière	*S. hemphilli* Coutière.	
S. nilandensis oxyceros Coutière	*S. hemphilli longicornis* Coutière.	
S. gravieri Coutière.		
S. pococki Coutière.		
S. merospiniger Coutière.[a]		
S. fossor Paulson.		
S. trionychis Coutière.		
S. triunguiculatus Paulson.		
S. bakeri Coutière	*S. nobilii* Coutière.	
S. physocheles Coutière.		
S. demani Borradaile.		
S. charon Heller.		
S. otiosus Coutière.		
S. paraneomeris Coutière	*S. fritzmülleri* Coutière.	
S. paraneomeris protatus, new name (=*S. paraneomeris oxyceros* Coutière).	*S. fritzmülleri elongatus* Coutière.	
S. heroni Coutière	*S. sanlucasi* Coutière.	

[a] For descriptions of this and other new extra-American species, see pages 89 to 93.

Table of distribution of the species of the genus Synalpheus—Continued.

PAULSONI GROUP.

Indo-Pacific forms.	American forms.	Mediterranean and West African forms.
S. paulsoni Nobili	*S. paulsonoïdes* Coutière.	
S. paulsoni liminaris Coutière.		
S. paulsoni rameswarensis Coutière.		
S. paulsoni kurrachecnsis Coutière	*S. lockingtoni*, new name (*A. leviusculus* Lockington).	
S. hululensis Coutière.		
S. tumidomanus Paulson and var. *exilimanus* Paulson?		*S. paulsoni senegambiensis* Coutière.
S. mushaensis Coutière.		
S. macculloch Coutière	*S. latastei* Coutière.	
	S. latastei tenuispina Coutière.	
S. latastei Coutière.		
S. acanthitelsonis Coutière.		
	S. apioceros Coutière.	
	S. apioceros sanjosei Coutière.	
	S. apioceros mayaguensis Coutière.	
	S. apioceros leiops Coutière.	
S. hastilicrassus Coutière	*S. apioceros desterronsis* Coutière.	
	S. townsendi Coutière.	
	S. townsendi productus Coutière.	
	S. townsendi mexicanus Coutière.	
	S. townsendi brevispinis Coutière.	
S. tricuspidatus (Heller).		

BREVICARPUS GROUP.

	S. brevicarpus (Herrick).	
	S. brevicarpus guerini Coutière.	
	S. minus (Say).	
	S. minus bahicnsis Coutière.	
	S. minus antillensis Coutière.	
	S. diguetí Coutière.	
	S. diguetí ecuadorensis Coutière.	

BIUNGUICULATUS GROUP.

S. biunguiculatus (Stimpson).		
(?) *S. spiniger* (Stimpson).		
S. biunguiculatus exilipes Coutière.		
S. biunguiculatus pachymeris Coutière.		
S. neptunus (Dana).		
S. laticeps Coutière.		
S. pescadorensis Coutière.		
S. lophodactylus Coutière.		
(?) *S. haddoni* Coutière.		

LÆVIMANUS GROUP.

	S. spinifrons (M. Edwards). (?)	
	S. longicarpus (Herrick)	*S. lævimanus* (Heller).
	S. longicarpus approxima Coutière.	
	S. goodei Coutière.	
	S. goodei occidentalis Coutière.	
	S. pandionis Coutière	*S. parfaiti* Coutière.
	S. pandionis extentus Coutière.	
	S. grampusi Coutière.	
	S. sanctithomæ Coutière.	
	S. brooksi Coutière.	
	S. brooksi strepsiceros Coutière.	
	S. brooksi dentheræ Coutière.	
	S. herricki Coutière.	
	S. herricki dimidiatus Coutière.	
	S. herricki angustipes Coutière.	
	S. tanneri Coutière.	
	S. pectiniger Coutière.	
	S. androsi Coutière.	
	S. rathbunæ Coutière.	
	S. paraneptunus Coutière.	
S. sladeni Coutière.		

The preceding table shows the relative importance of the several groups inhabiting the American coasts, and enumerates, without description, all the species of the genus *Synalpheus* which are known to me. There are also included a certain number of species, yet unpublished, from other localities.

This table brings out well an important fact; that is, that the species of the Paulsoni and Neomeris groups, especially the former, are the most widely distributed. This distribution accords with certain unspecialized characters which are found among them, namely, the short carpocerite, the rostrum always possessing an inferior vertical prolongation, continuing the ocellary beak, and the dactyls slender and elongated. The disappearance of the rostral partition, the elongation of the carpocerite, thick or not, and the shortening of the dactylopodites indicate forms less and less allied to the Hippolytidæ and more and more Synalphean.

Before examining more closely the relation of the groups of species to one another, I ought to mention that many of the forms described have received trinomial appellations and correspond consequently to what zoological nomenclature designates as varieties, races, or subspecies, and to that which the botanists know under the name of "petites espèces." In employing the trinomial name to designate certain forms allied to one another, I simply wish to say that the forms represented by these names appear to me to be less distant from the species to which I attach them than the species is from another species. Most often these subspecies come from different localities and appear also to be distinct geographical races. This is, however, probably a result of the fact that the localities cited were the only ones explored. One should not forget that the stations noticed, rather numerous in Florida and at the Bahamas, for example, are restricted to a few points on the thousands of miles of shore line along the entire Pacific coast and even on the Atlantic coast south of Florida. At other times these secondary forms, related to species easy to determine, come from the same locality as the species. This expression "same locality," in spite of its apparent precision, is most often very vague. Two closely allied forms can find upon the same reef very different conditions of life, which isolate them as completely as if a continent separated them. One species inhabiting a sponge, another living attached by its hooks upon some species of madrepore, appear to me to represent a case of this sort.

It is possible, then, that the trinomial appellation which I uniformly employ does not correspond in nature to facts exactly comparable; that certain of the "races," "subspecies," or "small species" which it serves to designate merit a distinct specific name; that others, on the contrary, may be variations incompletely fixed of a species in a state of actual instability, the limits of which it has not been possible for me to fix more completely.

To return to the groups of species of the genus *Synalpheus*, the one which I designate by the name of the PAULSONI group, presents a most remarkable geographical distribution. *S. paulsoni* Nobili (perhaps identical with *S. tricuspidatus* (Heller)) is a species with short carpocerite from the Red Sea and the Persian Gulf, the affinities of which are to my mind very clearly indicated; it is separated, first from the forms with carpocerite equally short, but distinguished by the spinous palm of the large chela, or by the basicerite almost unarmed above, and again from the forms with carpocerite more elongate; variation in this last direction leads to some forms with the carpocerite elongate and slender (*S. hululensis* Coutière, *S. tumidomanus* Paulson, the latter very distinct on account of its large eggs, producing mysis, and the spinous angles of the telson). In another direction there are found some forms in which the carpocerite is elongate as in those preceding, but, in addition, is swollen, and of an ovoid form (*S. acanthitelsonis* Coutière, *S. hastilicrassus* Coutière). In a third direction, finally, there are found some species differing from *S. paulsoni* by the more massive aspect of the appendages; though indicated by a form *kurracheensis*, this evolutional tendency is more accentuated in the species *S. latastei* from Australia, which occurs without change in Chile, and which is also represented in Brazil by the form *tenuispina*. In Australia again, the species *S. macculloch*i Coutière differs most markedly from *S. paulsoni kurracheensis* by the presence of large eggs producing mysis.

There are found forms derived from *S. paulsoni* at the Mascarene Islands and on the west coast of Africa, of which I have been able to study very unusual specimens from Cape Lopez and from Cape Verde; these are not strictly typical specimens, but can be separated only by careful study, and it is impossible for me to make them distinct species, in spite of the great actual geographical isolation, which can probably be considered as absolute.

On the American coasts are found exactly the same evolutional tendencies in this group; *S. paulsoni* and the other Indo-Pacific forms are not represented there by identical forms, but the differences are at times so slight that, without indication of locality, the identification would be very difficult. *S. lockingtoni* differs from *S. paulsoni* almost solely by the spine of the scaphocerite being longer in the latter and surpassing the carpocerite; with the exception of the place of origin, the second species would correspond to the "*oxyceros*" form so often met with that it appears to be almost a constant variation among the subspecies of a given species.[a]

[a] It is more convenient and expressive to designate by the name "*oxyceros*" every subspecies showing this variation, but in deference to the accepted rule of nomenclature which forbids duplication of names within a single genus, I have in this paper used different names having a similar meaning, as *longicornis, elongatus, productus, prolatus, extentus.*

This "*oxyceros*" form of *S. lockingtoni* exists, moreover, on the coast of Lower California. It is at present represented only by a single mutilated specimen collected by M. Diguet (Paris Museum), the characters of which I believe to have specific value, and which I designate by the name *S. paulsonoïdes*. Compared to *S. paulsoni*, instead of *S. lockingtoni*, it differs by its appendages and especially the third pair of feet, which are more slender. This comprises the known variations in this direction, the carpocerite remaining short, with the exception, of course, of *S. latastei* of Chile and its *tenuispina* form from Brazil just now cited.

The second evolutional direction (the carpocerite remaining slender while becoming much elongate) does not appear to be represented on the American coast; on the other hand, the forms with carpocerite long and swollen are predominant. *S. apioceros* Coutière is found here, accompanied by at least four varietal forms coming from California, Florida, the West Indies, Venezuela, and Brazil; in regard to the last four forms, one can not say whether the geographical isolation is real, or whether it only appears so because the intermediate connectives are not known; but the isolation of the Californian form is absolute, and yet the differences which separate it from the specimens from Florida are quite as slight and difficult to detect as are those which separate these last from the other three forms which the species assumes. While it is possible that there may be as many species quite distinct and unrelated to one another, yet it is absolutely undeniable that the characters of these five forms are less distant than are those which separate *S. apioceros* from *S. paulsoni*. Nomenclature does not permit the expression of this, discarding (with good reason) every hypothesis conveying the idea of a possible affiliation between species—affiliation to which the idea of these "lesser species" directly leads.

Another species with carpocerite less swollen is *S. townsendi*, very widely distributed on both shores of America. It differs most of all from the preceding in the superior spine of the basicerite being almost or quite absent, so that these two species show a striking parallelism with *S. acanthitelsonis* and *S. hastilicrassus* Coutière of the Maldives. *S. apioceros* and *S. acanthitelsonis* especially differ only in the angles of the telson, which are very sharp in the second species. The divergence is but little greater between the two others.

Those species with basicerite unarmed above are important from another point of view, in that they permit of a passage to the Neomeris group by certain forms, such as *S. parancomeris* Coutière. This species, very widely distributed from the Red Sea to the Hawaiian Islands, with several "races" (probably among them the "*oxyceros*" form), differs particularly from the American *S. townsendi* or from *S. hastilicrassus* of the Maldives by the dactyls of the

third, fourth, and fifth feet bearing a third and very obtuse ventral prominence. This prominence, very frequent in the NEOMERIS group, sometimes becomes a strong triangular hook, but a character still more often met with (with or without the last) is the reduction of the dorsal hook of the dactyl, the ventral hook taking the form and thickness of a wooden shoe, as in the curious species *S. charon* Heller. The Indo-Pacific region harbors a large number of species of this group, very easy to distinguish by reason of the characters in the striking form of the dactyls; among them those are especially curious in which exist—or reappear—the rows of spines of the meropodites, so constant in the primitive Eucyphota, and persisting in the Alpheidæ only on the propodite.

These forms of the NEOMERIS group with spinous meropodites appear to be totally absent from the American coasts. There also the parallelism with the Indo-Pacific forms is carried very far. Between *S. hemphilli* Coutière of Florida and *S. nilandensis* Coutière of the Maldives (both of which show an "*oxyceros*" form) there is no difference except the presence in the latter, and the absence in the former, of the meral spines; and yet, oddly enough, one quite full-grown specimen of *S. hemphilli*, from the Bermudas, shows on one side only a single meral spine. It is difficult to record such observations without thinking of a common origin for the two species, so completely separated at the present time, and yet so strictly parallel.

Another species, *S. fritzmülleri* Coutière of Florida and the West Indies, exists also in Venezuela and Brazil, where it is represented by the "*oxyceros*" form; it is found again in California with the meropodites more slender. In Ecuador *S. nobilii* Coutière, a form in which the meropodites are, on the other hand, shorter and more swollen, replaces *S. fritzmülleri*. In the Indo-Pacific region, *S. bakeri* Coutière, in which the supernumerary ventral prominence is very feeble, is the species most closely allied to the preceding ones.

Another very striking instance of parallelism is the existence in Lower California and in the Red Sea of the species *S. sanlucasi* Coutière and *S. heroni* Coutière respectively, both characterized by the very massive form of all the appendages. The modes of differentiation of the species are again repeated. A form being found, for example, with a short carpocerite, one may expect to meet those with a long carpocerite, then those with more slender members, with more massive members, with basicerite spinous above, or not, with large chela unarmed or spinous on the palmar border, those in which the angles of the telson are prolonged in a spine or not, etc. One can not avoid drawing the conclusion that such a constancy in the modes of variation strongly resembles an hereditary tendency, due to the small number of species from which the genus *Synalpheus* must have sprung.

The BREVICARPUS group is extremely like the PAULSONI group, and it is very possible that it may have been derived from the latter; the absence of an inferior vertical prolongation of the rostrum, the fact that all the species known have the carpocerite elongated, often swollen, indicate derivative and not primitive forms. On the other hand, it is there that are found the species having the largest antennal scale (*S. brevicarpus* Herrick), which is a character directly opposed to the preceding; but *S. brevicarpus* is a species with very large eggs producing mysis, a character which appears especially to show itself in those forms which are most highly developed. Finally, the BREVICARPUS group is, up to the present time, exclusively American. Should its presence be established in some part of the Indo-Pacific—in Australia, for instance—the American region would surely remain its true country. Compared to the preceding groups it has an unusual distribution, inasmuch as the species which compose it extend from the Bermudas to Brazil and from California to Ecuador, exactly like the American forms of the PAULSONI or NEOMERIS groups. These last appear to have had rather an Indo-Pacific origin, if one may judge by the number and variety of the forms which represent them in that region. One is led then to wonder if the origin of the BREVICARPUS group ought not to be sought for also in some of the species of the PAULSONI groups; this might have found only in American waters the conditions which have brought about its variations in the direction of the BREVICARPUS group.

Being given the form *brevicarpus*, the most typical species with small eggs is *S. minus* (Say), from which one is able to derive an "*oxyceros*" form from Brazil, an *antillensis* form with antennules short and carpocerite more swollen, and a form with antennules very long and slender, *S. digueti* Coutière from Lower California. A form of this species, *S. ecuadorensis*, exists upon the Pacific coast of South America. The species *S. brevicarpus* (Herrick) with very large eggs differs in its more slender carpocerite and larger antennal scale. It is the largest species of *Synalpheus* known. All these species are separated by slight differences. It is probable that *S. minus* (Say) comprises several "races" other than those indicated here and behaves as does *S. paulsoni* in the Indo-Pacific region.

The BIUNGUICULATUS group includes among its species *S. neptunus* (Dana), the types of which I have been able to examine, and specimens of which have also been sent me from Australia by Mr. McCulloch. *S. laticeps* Coutière, of the Maldives, is very like it. These two species have the finger of the small chela widened and spatuliform, ornamented besides with some long hairs, which in *S. neptunus* are arranged in rows. These hairs are directed obliquely downward, and isolated, which is not the usual disposition in the

group. In *S. biunguiculatus* Stimpson, in the forms *pachymeris* Coutière, *lophodactylus* Coutière, and *pescadorensis* Coutière, these hairs are disposed in tufts formed in line, directed obliquely downward or even perpendicular to the surface of the mobile finger (*S. lophodactylus* Coutière); at the same time, the chela terminating the second pair is provided with a large number of tufts of long hairs, some carried by the palm, especially on its lower face, others by the movable finger, these last arranged regularly in a brush.

Judging by the sketch of an Australian specimen at the British Museum, taken some time previously, *S. spiniger* (Stimpson), with recurved hook, would also fall in this group, but this is not significant at the present time.

No American species, unless it be *S. spinifrons* (H. Milne Edwards), belongs to the Biunguiculatus group; this species can be equally claimed by the Lævimanus group, this group, as I have pointed out, being the continuation, pure and simple, of the preceding one, the characters of which it extends to the extreme limit, especially those which concern the reduction of the antennal scale. The character which essentially distinguishes the two groups, in spite of its constancy and its importance, is itself only the variation in the cleansing apparatus present in the species of the Biunguiculatus group; the bristles of the chela of the second pair, especially those of the movable finger, have not persisted in the Lævimanus group, while the brush of the little chela of the first pair has acquired the quite remarkable development that I have described above. If one tried to express these facts in plain language one would say that the experiment of the numerous cleansing appliances had been abandoned in the descendants of certain of these species, and that a single apparatus, much more perfect, had been substituted for them.

The continuity of the two groups is so evident that it leads to this conclusion: If the species of the Biunguiculatus group are not represented on the American coasts, it is because they have all undergone the variation toward the Lævimanus group, with the exception, perhaps, of *S. paraneptunus* Coutière, a species particularly instructive because of the much more feeble development of the brush of bristles of the small claw.

In the Indo-Pacific region, on the other hand, this variation appears to be very rarely realized, since the only species which presents it up to the present time is *S. sladeni* Coutière, which has not, however, altogether the aspect of the American species of the Lævimanus group.

A rather similar condition is observed in the relations between the Paulsoni and Brevicarpus groups, with two differences: First, the species of these two groups are still found side by side on both American coasts; second, the known distribution of the Lævimanus

group is at present much less restricted than that of the BREVICARPUS group, since it is known in the Indian Ocean, on the west coast of Africa, and in the Mediterranean. If the idea of time could be introduced into these data, one would say that the differentiation of the BREVICARPUS group is more recent; thus would also be explained its presence exclusively in America as well as its coexistence with the PAULSONI group, from which it has come, and its relatively small number of species. All these characters are opposed to the much wider distribution of the LÆVIMANUS group, to the localization of the derived species of the BIUNGUICULATUS group and to the excessive development of the forms which characterize the LÆVIMANUS group.

The armature of bristles of the small claw gives to these forms a common aspect so characteristic that it can hardly be believed, in a superficial examination, that there is room for so great a number of species within a compass of differences apparently so slight. It is, however, probably true even further than I have indicated, that several of the races or subspecies have a specific value. On the whole, one may say that the species of this group tend toward the elongation of the wrist of the small claw and the suppression of the antennal scale. These two tendencies are met with occasionally within the same form, such as *S. longicarpus*, in which the length of the wrist varies from once to twice the width with the age of the specimens. But there are grafted onto this general plan some characters quite unexpected, such as the curious form of the fingers of the small claw in *S. pectiniger*, the excavated meropodites of *S. androsi*, and the basicerite with a longitudinally spinous superior surface, of *S. rathbunæ*. No other group gives the impression as does this one of having sprung from a single species, by "explosion" of its characters (to employ the expression of Standfuss), characters which might be regrouped by chance like a combination of letters.

Remarkable from a morphological point of view, the LÆVIMANUS group is no less remarkable as to conditions of existence. It is the only one in which a single haul of the dredge of the U. S. Fisheries steamer *Albatross* (Station 2413) has been able to bring up from 5,000 to 3,000 specimens (belonging to the two species, *S. longicarpus* (Herrick) and *S. pectiniger* Coutière). It is this group in which anomalies in the laying of eggs are met with most frequently; among 227 females of *S. pectiniger* (Station 2413), of which I have determined the sex by examining them singly with the greatest care, I have been able to find only two or three in which the pleura were normal and the eggs present, and have been able to find none with the very large eggs carried by the normal females. The males which accompany them are 320 in number, with some closely united, all inferior in size to the normal. I propose to conduct investigations

to determine whether the castration so general among these females is due to a parasite, Microsporidian or Bacterian, or simply to hunger. Neither do the *S. longicarpus* which accompany them possess their maximum size; the males are largely in excess, but the eggs of the female are altogether normal.

One frequently finds some anomalies of the same sort in *S. brooksi* Coutière, in which the eggs give rise also to mysis as in *S. pectiniger*. The eggs may be reduced to two or three; they are then very small and of a chalky aspect, and at the same time the size of the female is very much reduced. *S. rathbunæ* is known to me up to the present time only by some sterile females, very small, in which the pleura are extremely spinous as in the male.

These species appear, then, to be sometimes found in very precarious conditions, from the point of view of their perpetuation, and the study of these conditions would probably be most interesting; their abundance in the collections accords well with what Herrick says when he speaks of the constant fusillade which one hears on the reefs of the Bahamas from the movements of the Alpheids, and it seems to me that they would lend themselves to constant observation in an aquarium in such a manner as to make possible some "pure cultures" of a determined species.

After an examination of the facts, it is difficult to avoid the temptation to draw from them some hypothetical conclusions. When one investigates the distribution of the Synalpheids known at the present time, the most striking fact is the existence of forms almost identical in regions so remote as the Red Sea and California or Florida. Now, these are very sedentary animals, which are almost never seen to swim, but live in couples in sponges or madrepores; their larvæ, to be sure, could be disseminated by the currents, but the possible extent of that dissemination should not be overestimated, and when two species are separated by both the Pacific and the Indian oceans, they are certainly isolated in the most rigorous fashion. I can not repeat too often that the Indian *S. paulsoni* and the Californian *S. paulsonoïdes*, *S. mushaenis* and *S. lockingtoni*, *S. acanthitelsonis* and *S. apioceros*, *S. nilandensis* and *S. hemphilli*, etc., might very well, without indication of locality, be considered as simply "races," and there is the inevitable inference that former conditions under which the antecedent species lived permitted a very vast distribution. Nothing shows that these species still exist, but at all events they have changed, since the forms which represent them in different localities are no longer exactly comparable. There is, as an exception, only the single species *S. latastei*, the specimens of which from Chile I can not differentiate from another—a single one, it is true—from Australia. This exception, when critically examined, only goes to strengthen

very much the idea of species primitively widely dispersed; perhaps it will even render less uncertain the position of the continuous line of coast along which the dispersion might have been made. It seems to me that one might sketch this original distribution under the form of a few waves of very great amplitude, on which, at variable points, might have originated new systems of waves of the second order, of less amplitude. *S. paulsoni* at one extremity, *S. paulsonoïdes* at the other, would represent such systems, turning aside more or less from the wave of the first order, to continue the comparison, being able even to substitute themselves for it and to efface it. On these would be produced, by the same hypothetical mechanism, waves of the third order, of still shorter amplitude, as, for examples, the races or subspecies with trinomial appellations which are attached so obviously and so closely to *S. apioceros*, to *S. townsendi*, to *S. minus*, and to *S. herricki*. The comparison permits us even to imagine that the characters served at first to distinguish species, and that as the waves spread and multiplied they changed their original valuation and became characters of groups, and even generic characters.

In order to complete the hypothesis, one might speak of the "pebble" which, falling on the summit of a wave of great amplitude, might have given rise to a new system of vibrations, otherwise called a new form. If one seeks to represent the one or the other of the two possible mechanisms, insensible "fluctuations" or sudden "mutations," one encounters the same impossibility of knowing. It is easy to see at a glance that the two modes do not exclude each other, that they are even very near to overlapping, provided we admit an amplitude small enough for effectual variations. There are perhaps some zoological groups which behave in a different manner from this point of view. Each molt of an arthropod is a "mutation," while a vertebrate "fluctuates" in order to attain its adult characters. According to Professor Bouvier, who has in such a masterly manner demonstrated the reality of mutations among the Atyidæ and their great amplitude, it would not be surprising if one found among other Crustacea analogous examples.

I think I can say that the Synalpheids at the present time show nothing similar. I have examined, drawn, and measured all the specimens of which I speak, excepting in the cases where the species comprised several hundreds or more than a thousand specimens, which for want of time I have only examined. The details which can be referred to the facts of mutation by their unusual presence in a series of specimens appear to be very few in number and without special importance. For example, first, one of the specimens of *S. apioceros sanjosei* has no spine on the anterior border of the wrist, which fact permits of no hesitation in its determination; second, one

of the specimens of *S. hemphilli longicornis* bears a movable spine on one of the meropodites of the third pair; it is the reappearance, very interesting, of a character present in many of the NEOMERIS species (Indo-Pacific), which seems to have disappeared in the American species, even those most like the preceding. It is not a "mutation" permitting one to understand the process by which a new form is originated; third, a specimen of *S. minus* possesses on the anterior border of the palm of the small chela a spinous tubercle as on the opposing chela; this is a "mutation" which is not absolutely rare in the Alpheidæ, and which I have seen even carried so far as to result in the complete symmetry of the two claws of the first pair in a very curious specimen of *Alpheus dentipes* Guérin. But the Alpheidæ have originated from forms with symmetrical claws; there, again, it is the question of the recurrence of a remote character, and not the indication of a new evolutional line; fourth, some specimens of very small size of *S. longicarpus*, and of *S. brooksi* also, have only four segments in the carpus of the second pair; this detail characterizes the species *S. rathbunæ*, which is far from being the nearest to *S. brooksi*, but it characterizes also the genus *Arete*, the relations of which with the genus *Synalpheus* are truly very remote.

Concurrent with these facts, obvious, but without importance, may be cited other facts of greater weight but without proofs. The characters of the subspecies *S. brooksi strepsiceros*, *S. herricki dimidiatus*, *S. herricki angustipes*, and of *S. tanneri*, occurring either among a series of typical specimens or in some localities where the typical specimens also occur, make one think of some "mutations;" it is, in fact, as I have said before, the case in the entire LEVIMANUS group; close relationship, a general resemblance of the forms which make part of it, but a great variety of combinations of a small number of characters, of which one at least is absolutely constant, certain combinations rarely realized, while others are frequent—even taking into account certain errors in the appreciation of the scarcity or the frequency of the type—a distinct aspect and clear-cut, though slight, differences. These are mere impressions without proofs, but which, I believe, would occur to every naturalist who has been able to study in its entirety so homogeneous a group; and it would certainly be interesting to attempt for a few of the species of the LEVIMANUS group some "pure cultures," continued during several generations, supposing that one might surmount certain considerable difficulties involved in such an attempt.

This work, in which the greater part of the forms described are new, necessarily allows of very few bibliographical references; those pertaining to the species of Say, Herrick, and Lockington, the names of which I have been able to retain, are given with the descriptions

of these species; for all the others. I refer to my work on the Alpheidæ in general,[a] and to the paper on the Alpheidæ of the Maldives.[b]

DESCRIPTIONS OF SPECIES.

PAULSONI Group.

SYNALPHEUS LOCKINGTONI, new name.

Alpheus leviusculus LOCKINGTON, Ann. and Mag. Nat. Hist., 1878, p. 478; not *Alpheus edwardsi* var. *leviusculus* Dana, 1852.

I believe that I have rediscovered the species described by Lockington, although the specimens which represent it differ in slight details from his description.

FIG. 1.—SYNALPHEUS LOCKINGTONI. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *k′*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m′*, DACTYL OF THIRD PAIR; *t*, TELSON.

The rostrum is a little longer than the lateral spines; it reaches the extremity of the basal antennular article, from which it is separated by notches which are narrow, but not sharp, at the base.

The last two antennular articles are practically equal, the antennule being 4.4 times as long as wide; the basal article is only 1.5

[a] Annales des Sciences Naturelles (8), IX, 1899, pp. 1–56.

[b] The Fauna and Geography of the Maldive and Laccadive Archipelagoes, II, Pt. 4, 1905, pp. 852–920.

longer than the median; the stylocerite usually reaches the distal third of the median antennular article, but always to at least the middle of the article.

The lateral spine of the basicerite is as long as the rostrum; the lateral spine of the scaphocerite is very slightly shorter than the carpocerite, which is short, beginning at the distal third of the basal antennular article, three times as long as wide, the margins almost parallel, excepting at the base, where it is slightly swollen; it exceeds the antennule by one-half the length of the distal article; the outer maxillipeds exceed the antennule by about one-half of its length.

The anterior margin of the palm of the large chela terminates in a conical tubercle, short and always destitute of a spine, as Lockington distinctly says. I found the proportions of the chela to be: Finger 1; total length 3; height 1.1; proportion T. L.: H.=2.9:1. The anterior margin of the meropodite terminates in a triangular point.

The proportions of the small chela are: Fingers 1; total length 2.36; height 0.84; proportion T. L.: H.=2.8:1. The carpus is not spinous on its superior margin; the meropodite terminates on this margin in a triangular point, its thickness being a little less than that of the palm, contained 1.9 times in its length.

In the second pair the first segment of the carpus is slightly shorter than the sum of the four following ones; the meropodite is shorter than the carpus.

The meropodite of the third pair is approximately equal to the carpus of the second pair, and 3.75 times longer than wide. The proportions of the members are: Carpus 1; propodite 2; meropodite 2.15; the dactyl is very slender, the dorsal hook twice as long as the ventral.

The posterior angles of the telson are right angles, not prolonged to a triangular prominence.

Named for Mr. W. N. Lockington, the original describer of the species.

The description by Lockington—very explicit as to the length of the antennal spines, the form of the chela of the first pair, the carpus of the second pair, the dactyl of the third pair, and the telson—appears to permit identification of the specimens of *S. leviusculus* with those which I have studied. The differences bear upon two points: Lockington says that the spine of the scaphocerite does not reach the extremity of the peduncle and that the movable finger of the large chela projects beyond the pollex. The first character hardly exists on the specimens that I have seen, the spine being approximately equal to the carpocerite and the fingers of the large chela equal.

Lockington's specimens came from Port Escondido, Port Mulege, and other points in the Gulf of California. Those which I have studied were collected by the steamer *Albatross*, of the U. S. Bureau of Fisheries, on the California coast at Station 4421, eastern point San Nicolas Island N. 26° W. 3.8 miles, 229–298 fathoms.

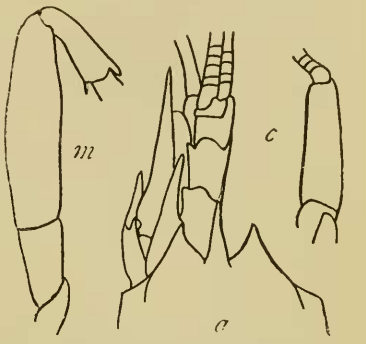

FIG. 2.—SYNALPHEUS PAULSONI. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *m*, PORTION OF THIRD FOOT.

This species is particularly important because of its resemblance to *S. paulsoni* Nobili from the Red Sea and the Persian Gulf. There is but one difference between the two species: The spine of the scaphocerite in *S. paulsoni* always exceeds the carpocerite. If, however, one were studying the two species without a knowledge of their source, one would be led to make of the *S. paulsoni* an "*oxyceros*" form of *S. lockingtoni*.

S. paulsoni, in the group which bears its name, is a form with short carpocerite, that article arising a little below the extremity of the basal article of the antennule. It is a character which seems to me to be very essential for the diagnosis of the species of the group, the carpocerite being elongated and slender or elongated and thick, and also important because the forms with short carpocerite may be considered as less developed, as that article is always short in the primitive Eucyphota.

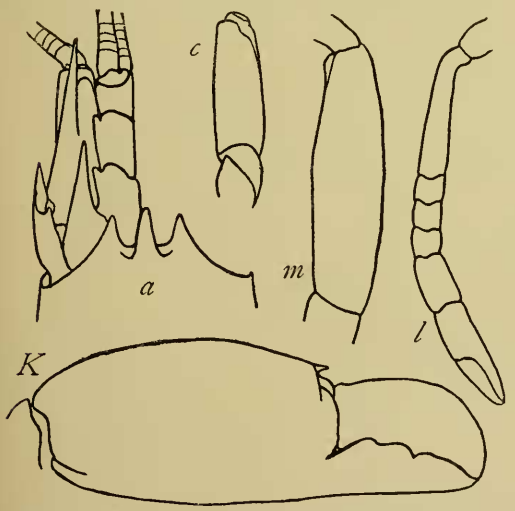

FIG. 3.—SYNALPHEUS PAULSONI KURRACHEENSIS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *l*, FOOT OF SECOND PAIR; *m*, MEROPODITE OF THIRD PAIR.

In the Indo-Pacific region, *S. paulsoni* is surrounded by a certain number of derived forms: *S. paulsoni liminaris* Coutière, in which the carpocerite is a little longer and the basicerite almost unarmed above; *S. paulsoni rameswarensis* Coutière, in which the interior palmar border is spinous; and *S. paulsoni kurrachcensis* of a more massive general form, very interesting, in that it indicates the direction

in which the species *S. latastei*, of Australia and Chile, is differentiated. I have believed it possible to separate as a distinct species *S. hululensis* Coutière from the Maldives, which I have described in my work on the Alpheidæ of that archipelago under the name of *S. tumidomanus* Paulson; but *S. tumidomanus* is very distinct from it, as shown by the angles of the telson being clearly spinous (as Paulson has figured it), and also by the very large eggs which give rise to mysis. In these last two forms the carpocerite has become distinctly elongate and slender (at least four times as long as wide).

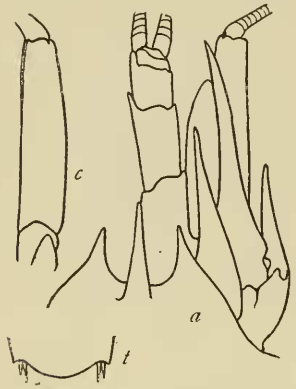

FIG. 4.—SYNALPHEUS HULULENSIS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *t*, TELSON.

I have also separated from *S. paulsoni*, under the name of *S. mushaensis* Coutière, a specimen from the Red Sea, received from M. Gravier, in which the antennal scale is notably shorter than the antennule and still shorter than the carpocerite. This species is again extremely like *S. lockingtoni* from California and Lower California.

Although the forms with a short carpocerite are at present less numerous on the Californian coast than those with a long one, the parallelism between them and those of the Indo-Pacific is again accentuated by the following species which I believe should be separated from *S. lockingtoni*.

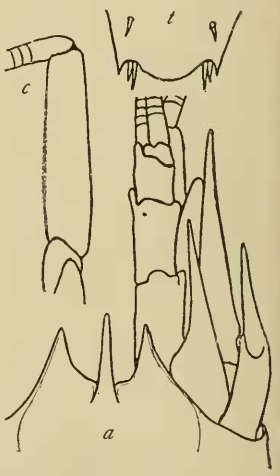

FIG. 5.—SYNALPHEUS TUMIDOMANUS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *t*, TELSON.

SYNALPHEUS PAULSONOÏDES, new species.

The species differs from *S. lockingtoni* by the following points:

The antennal scale equals the antennule, and the lateral spine of the scaphocerite considerably exceeds the carpocerite, which is four times as long as wide. The carpus of the small cheliped has its anterior border prolonged in a spinous prominence. The feet of the third pair are very slender. Their proportions are: Carpus 1; propodite 2; meropodite 2.35; this last being 5.3 times as long as wide.

The specimen, a male, is unique and its large cheliped is wanting; but it is very easily distinguished from *S. lockingtoni*, especially by the slenderness of the meropodites of the third pair. It corresponds, as the Indo-Arabic *S. paulsoni*, to an "*oxyceros*" form of the species

previously cited, but in a different direction. Up to the present time, in fact, I know of no form which is exactly the same in both regions.

S. paulsonoïdes is from the island of San José, Lower California (M. Diguet, Paris Museum).

On the South American coasts the species with short carpocerite of the PAULSONI group are similarly represented. The species *S. latastei* Coutière, described below, is of great interest. It possesses in Brazil a "*tenuispina*" form which is with difficulty separable from some specimens from Cape Lopez, in West Africa. On the other hand, it exists in Australia, for I can not differentiate from the typical Chilean specimens the unique Australian individual which I have examined. In Australia, moreover, a species with very large eggs, *S. macculloch*i, is shown to be closely allied, and *S. paulsoni kurrachcensis*, previously cited, clearly resembles it also, though its appendages are a little more massive.

FIG. 6.—SYNALPHEUS PAULSONOÏDES. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *m*, MEROPODITE OF THIRD FOOT.

SYNALPHEUS LATASTEI, new species.

The rostrum is longer than the frontal spines, and also wider; the antennular articles are short and approximately equal; the proportion of the antennule is only 1:3.85, the diminution in length affecting especially the basal article; the stylocerite is shorter than in *S. lockingtoni;* the lateral spine of the basicerite is as long as the stylocerite; its superior spine is short and strong.

The antennal scale, rather reduced, is 5.7 times as long as wide, and its long and strong lateral spine exceeds the antennule by the length of the distal article, and usually slightly exceeds the carpocerite, which arises from the same level as the median antennular article; the proportion of its dimensions is 1:2.71, sometimes even 2.66; its form is more cylindrical than in *S. lockingtoni.*

The large chela, which recalls the preceding species by the absence of any spinous prominence on the anterior margin of the palm, differs from it by its more stocky form: Fingers 1; total length 3.4; height 1.5. The small chela has the same proportions as in *S. lockingtoni;* the meropodites of the two chelipeds terminate on the superior margin in a spinous prominence.

In the second pair, the first article of the carpus, the four following and the chela are to one another as 1.2, 1.25, 1. The proportions of the third pair are: Meropodite 2; carpus 1; propodite 1.6; the meropodite is 3.12 times longer than wide, and consequently very stout.

The telson has the same form as in *S. lockingtoni*. This species seems to be frequent in Chile, from which locality I have been able to examine some ten specimens, thanks to M. Lataste, of the Paris Museum, after whom the species is named; the species is also met with in Australia (?) (one male of great length without indication of locality other than New Holland; Paris Museum).

The size is greater than in *S. lockingtoni*. It reaches 30.5 mm. in length from the rostrum to the telson.

I have been obliged to separate from the typical species, under the name *S. latastei tenuispina*, a large female from Desterro which dif-

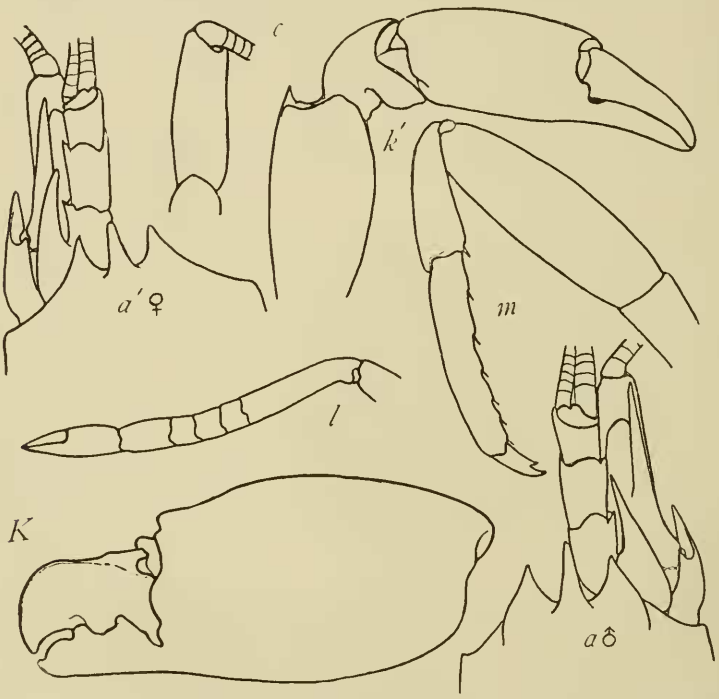

FIG. 7.—SYNALPHEUS LATASTEI. *a*, FRONTAL AND ANTENNAL REGION, MALE, AUSTRALIA; *a'*, FRONTAL AND ANTENNAL REGION, FEMALE, CHILE; *c*, CARPOCERITE; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR.

fers from it in the following points: The antennule is less thick (four times as long as wide instead of 3.85); the scale of the scaphocerite equals the antennule, and its very sharp lateral spine exceeds the carpocerite very considerably, the latter being 3 times, or even 3.04 times, longer than wide. The meropodite of the third pair is 3.3 times as long as wide, instead of 3.1 times, as in *S. latastei*.

This form approaches closely to *S. lockingtoni* from California and Lower California, differing from it, however, by the large and more massive chela (proportions T. L.: H. = 2.5:1 instead of 2.9:1), the

fingers of which are shorter (fingers 1, height 1.4, instead of 1.1). The feet of the third pair are also more massive (meropodite 3.3 times as long as wide instead of 3.74), and the feet of the second pair, as in *S. latastei*, have the distal chela feeble and the first segment of the carpus equal in length to the four following ones.

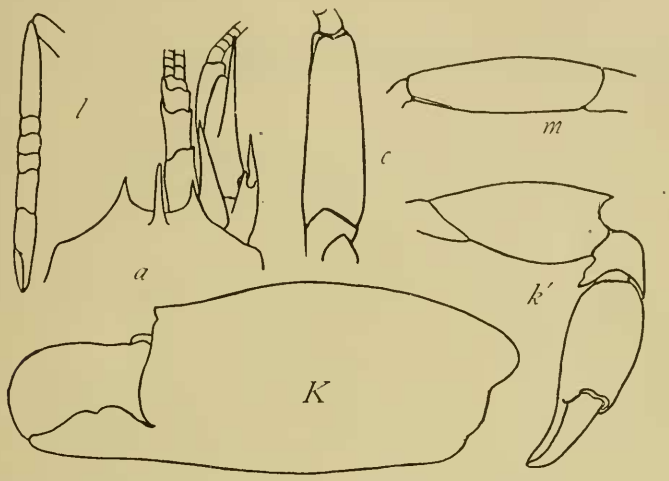

FIG. 8.—SYNALPHEUS LATASTEI TENUISPINA. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *k′*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, MEROPODITE OF THIRD PAIR.

Desterro, Brazil; Fritz Müller; one female 30 mm. long (Paris Museum).

SYNALPHEUS APIOCEROS, new species.

On the Atlantic coast of America the PAULSONI group is represented by additional species; one of them, *S. townsendi*, described farther on, is, up to the present time, the most aberrant form of the group known; it possesses no spine in the superior angle of the basicerite, and thus closely resembles *S. paraneomeris* of the NEOMERIS group; this resemblance is further accentuated by the fact that the dactyls of the third, fourth, and fifth pairs in the preceding species possess only a trace of triunguiculation. Thus these two species mark the varietal limits of the two groups of forms.

The other species, *S. apioceros*, also new, is, on the other hand, very typical. It is of special interest because of the great number of allied forms, American or Indo-Arabic, which may be approximated to it.

The rostrum is equal to the lateral teeth, from which it is separated by intervals acute at base; the antennule is about 4.6 times as long as wide, but its basal article is 2.2 times as long as the median, and considerably exceeds the frontal teeth. This is a character which distinguishes this species at once from *S. lockingtoni*.

The stylocerite scarcely reaches the middle of the median article; the superior spine of the basicerite nearly equals the frontal teeth; its lateral spine does not reach the extremity of the basal antennular article; the scale of the scaphocerite, five times as long as wide, is shorter than the antennule, its lateral spine slightly shorter than the carpocerite, which last, three times as long as wide, is swollen at the base and pyriform; it is long in the sense that it takes its origin below the point where the stylocerite is detached from the basal article of the antennule and that it exceeds the antennule by about two-thirds of its distal article.

The outer maxillipeds do not exceed the carpocerite. The large chela has the following proportions: Fingers 1; total length 3.15;

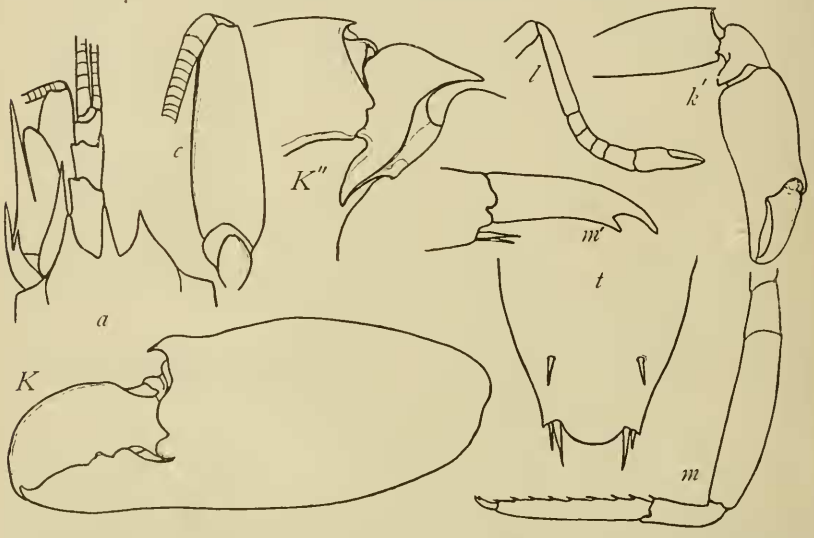

FIG. 9.—SYNALPHEUS APIOCEROS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *K''*, CARPUS OF LARGE CHELIPED; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON.

height about 1.28; the proportion T. L.: H.=2.8:1; the anterior border of the palm is swollen in a tubercle, which terminates in a spine directed slightly obliquely downward.

The small chela has, as proportions, fingers 1; total length 2.8; height 0.95; T. L.: H.=2.95:1; it is thus relatively slender with short fingers; the wrist is spinous on its supero-external border; the meropodite, a little less thick than the palm, is 2.35 times longer than wide. The proportion of the two chelæ is about 1:3.

In the second pair the first segment of the carpus equals apparently the sum of the others, and the meropodite is more slender than in *S. lockingtoni;* the chela is also notably shorter.

The proportions of the third pair are: Carpus 1; propodite 2; meropodite 2.28, this last being a little more than four times as long as

wide. The dactyl is slender, about 3.2 times as long as wide, with the ventral hook relatively shorter than in *S. lockingtoni*.

The telson has its posterior angles accented, but not spinous. The eggs give rise to zoëa larvæ.

Localities:

Jamaica, *Albatross*.

Marco, Florida, 1 to 3 fathoms, H. Hemphill (Cat. No. 7000).

Marco, Florida, in sponges, H. Hemphill (Cat. No. 6970), type.

The species differs, then, from *S. lockingtoni* in many ways; the rostrum and stylocerite are shorter, the basal article of the antennule is longer, the carpocerite of different form and proportions, the maxillipeds shorter, the large chela is spinous on the palmar border, the small cheliped is more slender, its carpus spinous and the second and third pairs are more slender.

One is induced to separate from *S. apioceros* a whole series of forms of different geographic origin, probably constituting as many distinct species. They differ, nevertheless, very little from typical specimens and correspond well to what are called "petites espèces."

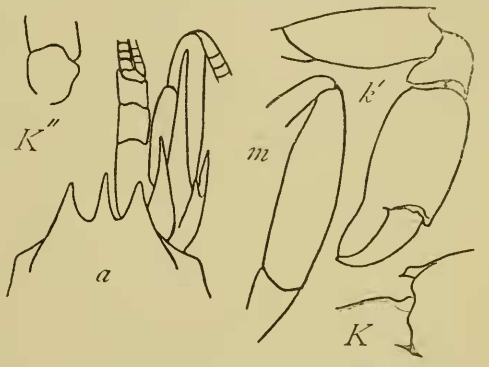

FIG. 10.—SYNALPHEUS APIOCEROS SANJOSEI. *a*, FRONTAL AND ANTENNAL REGION; *K*, SPINE OF LARGE CHELA; *K″*, CARPUS OF LARGE CHELIPED; *k′*, SMALL CHELIPED OF FIRST PAIR; *m*, MEROPODITE OF THIRD PAIR.

SYNALPHEUS APIOCEROS SANJOSEI, new subspecies.

This subspecies is represented only in the collection of the Museum at Paris by some specimens (male and female) collected by M. Diguet. It is from San José Island, Lower California, and is as distinct from *S. lockingtoni* of California as is the preceding, from which it differs in the following details:

The rostrum is usually a little longer than the lateral spines; the stylocerite scarcely surpasses the basal article of the antennule; the lateral spine of the scaphocerite is notably shorter than the carpocerite; the carpus of the small cheliped is unarmed above. The small chela has these proportions: Fingers 1; total length 2.56; height 1.1; T. L.: H.=2.34:1; it is thus more massive than in *S. apioceros*, where the last proportion is 2.95:1.

The meropodite of the third pair is 3.56 times as long as wide.

SYNALPHEUS APIOCEROS MAYAGUENSIS, new subspecies.

I have examined four specimens from Porto Rico belonging to this form. They are not, however, strictly alike. The most typical among them differ from *S. apioceros* in the following particulars:

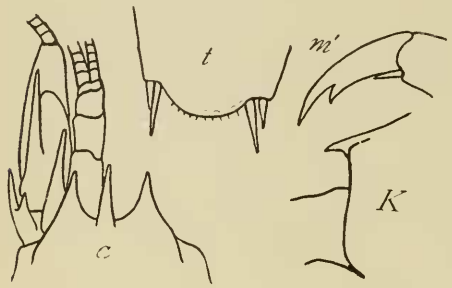

FIG. 11.—SYNALPHEUS APIOCEROS MAYAGUENSIS. *a*, FRONTAL AND ANTENNAL REGION; *K*, SPINE OF LARGE CHELA; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON.

Rostrum a little longer than the lateral spines; stylocerite attaining at least the middle of the median article of the antennule; scale of the scaphocerite only four times as long as wide; carpocerite surpassing the antennule by 1½ times the length of the distal article, longer than the spine of the scaphocerite, and very swollen at base (only 2.8 to 2.9 times as long as wide); the spine of the large chela continues in a straight line the anterior margin of the palm, which presents no swollen tubercle; the dactyl of the third pair is 3.8 times as long as wide and its ventral hook is more feeble than in *S. apioceros;* the posterior angles of the telson are right angles.

The other specimens are distinguished from the preceding by slight differences in the width of the antennal scale, in the more slender feet of the second and third pairs, and by the more marked posterior angles of the telson. It is probable that more abundant material would permit of separating them also from *S. apioceros.*

Type.—Cat. No. 24785, U.S.N.M. Mayaguez, on coral reef.

SYNALPHEUS APIOCEROS LEIOPES, new subspecies.

Some females collected by M. Chaper (Paris Museum) differ from *S. apioceros* in the following points:

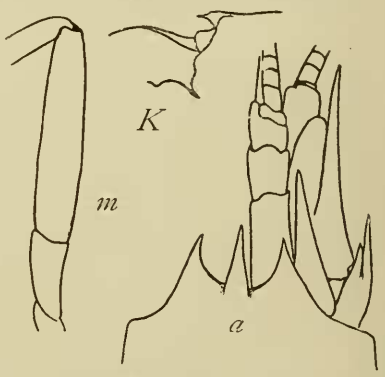

FIG. 12.—SYNALPHEUS APIOCEROS LEIOPES. *a*, FRONTAL AND ANTENNAL REGION; *K*, SPINE OF LARGE CHELA; *m*, PORTION OF THIRD FOOT.

The lateral spine of the scaphocerite always slightly exceeds the carpocerite; the feet of the third pair are more slender, the meropodites being 4.4 times longer than wide; the telson has its posterior angles right angles.

Venezuela, precise locality unknown. Type in Paris Museum.

SYNALPHEUS APIOCEROS DESTERROENSIS, new subspecies.

This form is more distinctly separated from *S. apioceros* than the preceding; it is also more abundantly represented. The specimens (4 males, 3 females) come from Desterro (Fritz Müller; Paris Museum).

The rostrum is separated from the lateral spines by wide intervals with sinuous base; the basal article of the antennule is only twice as long as the median article, and the antennule scarcely four times as long as wide; the scale of the scaphocerite is from 4.1 to 4.3 times as long as wide, at least equal to the antennule, or longer; the lateral spine of the scaphocerite surpasses it very little, being shorter itself than the carpocerite; the maxilliped exceeds the antennule, and slightly the carpocerite; the spine of the large chela continues the anterior palmar border; the feet of the third pair are very slender, the meropodite being about 4.7 times as long as wide; the posterior angles of the telson are right angles.

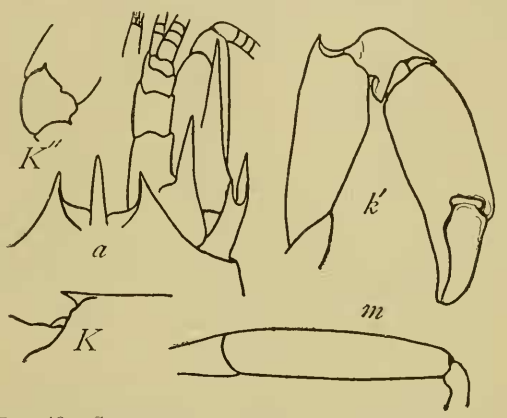

FIG. 13.—SYNALPHEUS APIOCEROS DESTERROENSIS. *a*, FRONTAL AND ANTENNAL REGION; *K*, SPINE OF LARGE CHELA; *K''*, CARPUS OF LARGE CHELIPED; *k'*, SMALL CHELIPED OF FIRST PAIR; *m*, MEROPODITE OF THIRD PAIR.

All these forms, like *S. apioceros*, have zoëa larvæ. None possess large eggs. They themselves present slight individual variations when the specimens representing them are numerous, and it is probable that they will be isolated hereafter as distinct species. I have noticed in one of the specimens of *sanjosei* the absence of the spine on the anterior border of the carpus. This is an example of a type of "mutation" with which one frequently meets in the Synalpheids, and which is of very slight importance.

In the Indo-Pacific region the forms with long and slender carpocerite, analogous to the preceding, have as the type *S. acanthitelsonis* Coutière, which differs from them almost solely by the very spinous angles of the telson, and *S. hastilicrassus* Coutière, in which the superior angle of the basicerite is unarmed, and which consequently is closely allied to the species described hereafter.

SYNALPHEUS TOWNSENDI, new species.

The rostrum is $1\frac{1}{2}$ times as long as the lateral teeth, reaching usually to the end of the proximal third of the median article of the

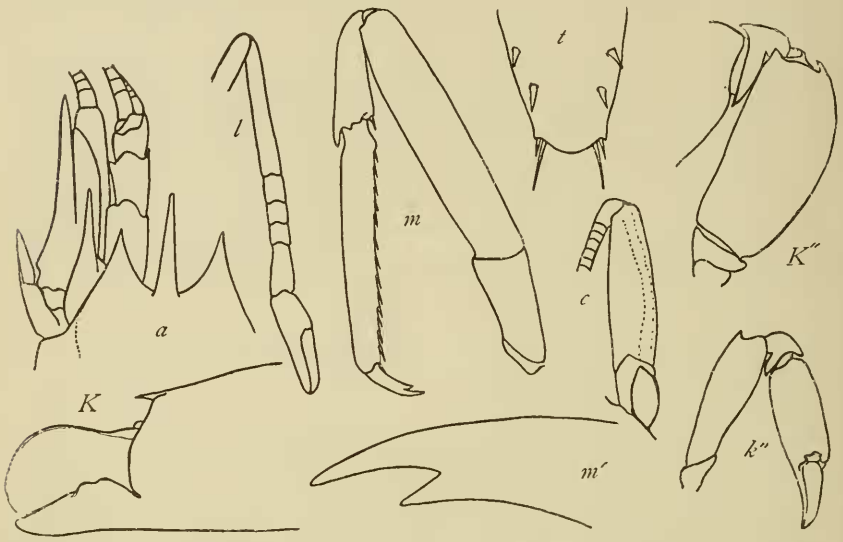

FIG. 14.—SYNALPHEUS TOWNSENDI. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *k''*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON.

antennule. On some specimens the frontal teeth are longer and more slender. The relative proportions of the articles of the antennule are: 2, 1.3, 1. The stylocerite reaches almost the middle of the median article.

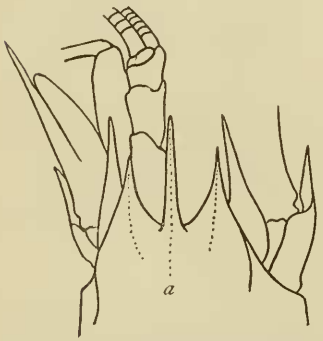

FIG. 15.—SYNALPHEUS TOWNSENDI PRODUCTUS. *a*, FRONTAL AND ANTENNAL REGION.

The basicerite bears no spine above, where it terminates in an obtuse angle; its lateral spine reaches to the distal third, sometimes even to the extremity of the basal antennular article: the antennal scale is 5.6 times longer than wide; its lateral spine is long and reaches beyond the extremity of the carpocerite, which is scarcely longer than the antennule, and is 3.5 times as long as wide.

The large chela has the following relative dimensions: Fingers 1; total length 3.65 to 3.7; height 1.25; the anterior border of the palm bears a sharp spine; the carpus is very small, in the form of a coin; the supero-external margin of the meropodite (which is twice as long as wide) is very convex, terminated by a hooked spine.

The small chela is one-third as long as the large one; its relative dimensions are: Fingers 1; total length 2.5; height 0.8 or a little less. The meropodite is 3.1 times longer than wide; its upper margin ending in a sharp angle.

In the second pair, which is slender and elongate, the first article of the carpus measures 1, the sum of the four following is 0.83, and the chela 0.75.

The relative dimensions of the third pair are: Meropodite 2.41 (five times longer than wide); carpus 1; propodite about 2.14, the foot as a whole being long and slender, especially the propodite; the dactyl is also elongate, its ventral hook less thick and especially much shorter (about one-third) than the dorsal, with which it is parallel in direction.

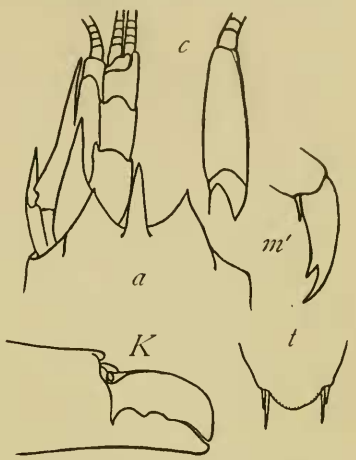

FIG. 16.—SYNALPHEUS TOWNSENDI BREVISPINIS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON.

The telson has sharp posterior angles, with the inner pair of spines very slender, three times longer than the outer pair; the convex posterior border has twelve plumose hairs.

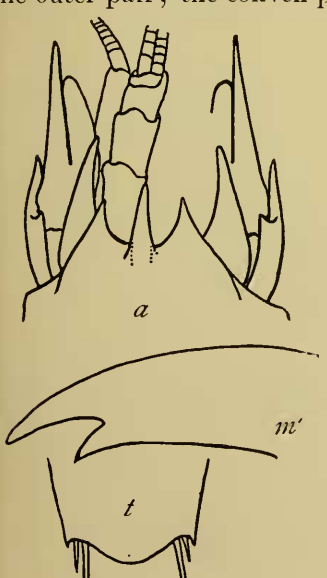

FIG. 17.—SYNALPHEUS TOWNSENDI MEXICANUS. *a*, FRONTAL AND ANTENNAL REGION; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON.

The eggs should give, in acordance with their size, zoëa larvæ.

This species represents on the American coasts *S. hastilicrassus* of the Laccadives and Maldives. The latter is distinguished by the large cheliped, in which neither the palm nor the meropodite is spinous, by the shorter dactyls of the thoracic feet, in which the ventral hook is the more important, by the telson having more pronounced angles, and the inner spines shorter than in *S. townsendi*. The carpocerite is also more swollen than in the last-named species.

S. townsendi shows some interesting variations. In a male specimen from *Albatross* Station No. 2406 (form *productus*) the rostrum and the frontal spines are very elongate, as is also the lateral spine of the scaphocerite. This "*oxyceros*" form (very frequent in *Synalpheus*), is seen likewise in the Maldivian species, *S. hastilicrassus*, at least as to the elongation of the rostrum.

This species is chiefly Atlantic, being known from the Bermudas, from Florida, the Bahamas, Cuba, and Porto Rico. It extends as far as Brazil, and, strange as it may seem, the *Albatross* collected it at the Hawaiian Islands at Station No. 3969. The species is met with, however, on the Pacific coast of America, represented by some specimens collected by M. Diguet (Paris Museum), which differ from those just described by the large chela, which has the palm obtuse, and the telson, in which the posterior angles are altogether right angles and the inner spines are shorter (form *brevispinis*).

Other specimens from the same region, collected by the *Albatross* (form *mexicanus*) have the basicerite slightly acute on the upper border; the frontal projections are short, the rostrum shorter than the basal article of the antennule; the ventral hook of the dactyls is a little larger, and the posterior angles of the telson are sharper than in typical specimens. These are very interesting differences, because they are the same which serve to separate the two species of the Maldives, *S. hastilicrassus* and *S. acanthitelsonis*, but here the characters of the basicerite and of the telson are much more marked.

Named for Mr. Charles Haskins Townsend, formerly naturalist of the *Albatross*.

Localities:

North Carolina, 15 to 16 fathoms, *Albatross* Station Nos. 2280 and 2619.

Florida: Key West (Union University collection); Anclote; Straits of Florida, 56 fathoms, *Albatross* Station No. 2640; west coast, 12.5 to 28 fathoms, *Grampus* Stations Nos. 5094 and 5100 and *Fish Hawk* Stations Nos. 7106, 7123 and 7124.

Gulf of Mexico, 24 to 32 fathoms, *Albatross* Stations Nos. 2369, 2372, 2373 (type), 2387, 2389, 2390, 2405, 2406 (type of *townsendi productus*), 2407, 2409, 2410, 2411, 2412, 2414.

Yucatan, off Cape Catoche, 24 to 27 fathoms, *Albatross* Stations Nos. 2362, 2365, 2366.

St. Thomas, *Albatross*, and *Fish Hawk* Stations Nos. 6079, 6080, in 20 to 23 fathoms.

Porto Rico, Mayaguez Harbor, 4 to 6 fathoms, *Fish Hawk* Station No. 6065.

Culebra, 15 to 15.25 fathoms, *Fish Hawk* Stations Nos. 6087 and 6093.

Vieques, 15 to 16 fathoms, *Fish Hawk* Stations Nos. 6091 and 6092.

Bermuda, G. Brown Goode.

Localities—Continued:

Brazil, Bahia, Hartt Expedition, Station No. 173.

Hawaiian Islands, French Frigate Shoal, 15 to 16 fathoms, *Albatross* Station No. 3969.

Southern part of Gulf of California, 9½ fathoms (type of form *mexicanus*), *Albatross* Station No. 2826.

Lower California (form *brevispinis*), M. Diguet (Paris Museum).

Type of *S. townsendi*.—Cat. No. 38392, U.S.N.M.

Type of *S. townsendi productus*.—Cat. No. 9798, U.S.N.M.

Type of *S. townsendi mexicanus*.—Cat. No. 38393, U.S.N.M.

S. townsendi is particularly close to *S. paraneomeris* Coutière, a form with basicerite unarmed above, which also presents variations in the armature of that article, as does an "*oxyceros*" form. The difference consists principally in the supernumerary ventral prominence of the dactyls, absent in *S. townsendi*, but very characteristic of the NEOMERIS group, where a great number of species possess it. *S. paraneomeris* is one of the most widely distributed species of the Indo-Pacific region.

NEOMERIS Group.

SYNALPHEUS FRITZMÜLLERI, new species.

Rostrum slender, quite distinct from the lateral spines, the margins nearly parallel for half their length; lateral spines with sharp points, generally a little shorter than the rostrum, reaching to the middle of the basal antennular article.

The articles of the antennule are in the proportion: 1.5, 1.1, 1, beginning at the base; the external flagellum is bifurcate beginning at the eighth article; the stylocerite equals one-half of the median antennular article.

The basicerite of the antennæ bears on the upper side a strong spine, laterally a longer spine, a little shorter than the stylocerite; the antennular scale is narrow (6.6 times longer than wide), its sharp lateral spine reaching the extremity of the carpocerite, which surpasses the antennule by about half the distal article and is a little swollen and only three times longer than wide.

The external maxillipeds reach forward to the bifurcation of the external antennular flagellum.

The relative proportions of the large chela are: Fingers 1; total length 3.15 to 3.3; height 1.25; the anterior margin of the palm bears an obtuse prominence; the meropodite is 2.3 times longer than wide, its inferior margin terminating in a strong triangular point.

The proportion of the small chela to the large one is as 1 to 2.5. Its relative dimensions are: Fingers 1; total length 2.2; height 0.72; its meropodite also ends in a strong triangular lobe.

In the second pair the first article of the carpus is approximately equal to the four others taken together; the chela is a little shorter; the meropodite measures about 0.8 of the length of the carpus.

The relative proportions of the third pair are: Meropodite 2.33; carpus 1; propodite 2, or a little less; the meropodite is 3.5 times longer than wide, this proportion diminishing in adult females or in males of small size to 3.7; it reaches even 4 in a perfectly typical

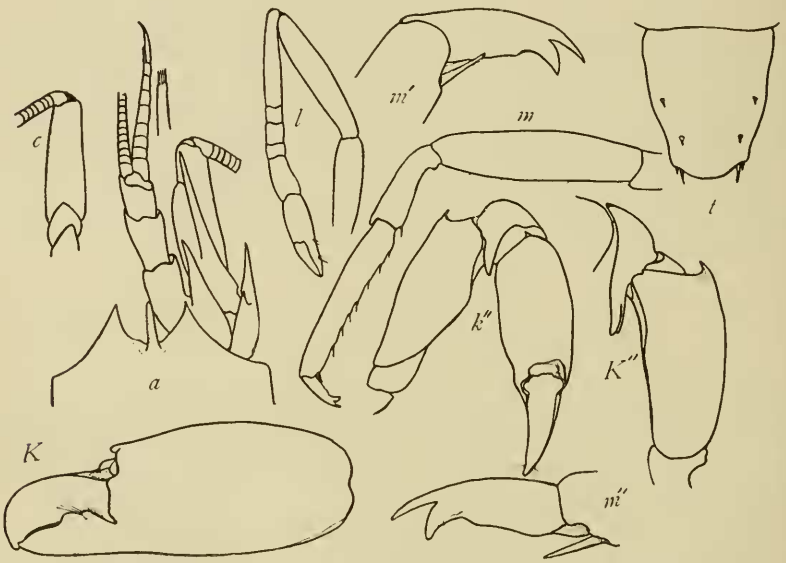

FIG. 18.—SYNALPHEUS FRITZMÜLLERI. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *k''*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *m''*, REVERSE OF SAME; *t*, TELSON.

female from Cape Florida; the two hooks of the dactyl are divergent, the ventral nearly twice as thick as the dorsal, with the anterior margin more convex; it does not directly continue the inferior margin of the dactyl, rejoining it by a concave curve of short radius in such a manner as to form a third obtuse prominence.

The telson has its posterior angles obtuse, its posterior margin bears twenty plumose hairs between the two pairs of habitual spines.

The eggs are of small size, and the larvæ are zoëæ.

The typical specimens are from Florida, some of them living in sponges; the species is also met with in Porto Rico and in Jamaica. In these three regions the typical examples predominate, but the

species also occurs in the "*oxyceros*" form (subspecies *elongatus*), the lateral spine of the scaphocerite greatly exceeding the carpocerite of the antennæ, and the rostrum being frequently longer than the lateral spines. The subspecies *elongatus* seems to be almost the only one in Venezuela and Brazil. Some specimens received from M. Chaper (Venezuela), others received from Fritz Müller from Desterro, and a small specimen from Bahia (R. Rathbun, Hartt Explorations) are without exception *elongatus*. Aside from their longer antennal spine, these specimens have the carpocerite less thick (3.3 to 3.4 times longer than wide), and the feet of the third pair more slender, the meropodite being 3.8 to 4 times longer than wide; but this last character varies with the size, and also with the sex, in the typical specimens within a rather wide range. With the material at my disposal I can not form a conclusion as to the advisability of the specific separation of this *elongatus* form.

FIG. 19.—SYNALPHEUS FRITZMÜLLERI ELONGATUS. *a*, FRONTAL AND ANTENNAL REGION.

The species is also found in Lower California, from which locality I have been able to study a single male specimen collected by M. Diguet, which does not differ from the Florida specimens in regard to the antennæ; the feet of the third pair are slender, the meropodite being four times as long as wide; but I find the same figures among the small typical males of Florida, of corresponding size, so that I can not separate this specimen from Lower California, even as a distinct "race."

Named for the naturalist, Dr. Fritz Müller.

Localities:

Typical specimens—

Cape Florida, Edward Palmer, 1 specimen.

Key West, Union University collection, 2 specimens.

Key West, H. Hemphill, 2 specimens.

Marco, Florida, H. Hemphill, 10 specimens, male and female, types.

Florida, west coast, 28 fathoms, *Fish Hawk* Station No. 7123, 1 specimen.

St. Thomas, *Albatross*, 1 specimen.

Mayaguez, Porto Rico, *Fish Hawk*, 4 specimens.

Lower California, M. Diguet (Paris Museum), 1 specimen.

Subspecies *elongatus*—

South Carolina, Mouth of Bull Creek, *Fish Hawk*, 1 specimen, type.

Florida, Eastern Dry Rock, Edward Palmer, 1 specimen.

Localities—Continued:

Subspecies *elongatus*—Continued—

Florida, St. Martins Reef, Lieut. J. F. Moser, U. S. N., 1 specimen.

Florida, H. Hemphill, 1 specimen.

Florida, Key West, Union University collection, 1 specimen.

Jamaica, *Albatross*, 3 specimens.

Venezuela, M. Chaper, Paris Museum.

Bahia, Hartt Explorations, R. Rathbun, 1 specimen.

Desterro, Fritz Müller, Paris Museum.

Type of *S. fritzmülleri*.—Cat. No. 6970, U.S.N.M.

Type of *S. fritzmülleri elongatus*.—Cat. No. 38394, U.S.N.M.

SYNALPHEUS HEMPHILLI, new species.

The species is very like the preceding, the differences being as follows:

The rostrum is always much longer (about twice) than the lateral spines; the feet of the third pair are a little shorter and thicker, their relative proportions being, carpus 1; meropodite 2.5; propodite about 2; the meropodite is 3.5 times longer than wide; on the dactyl the ventral hook is perpendicular to the lower border and its margins form a double curve, convex, then a little concave to the point; behind, the very marked third prominence forms a right angle at the summit, projecting a little in a spine.

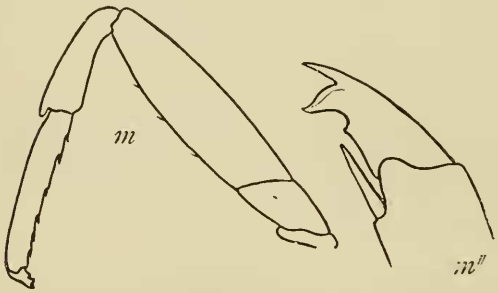

FIG. 20.—SYNALPHEUS HEMPHILLI. *m*, FOOT OF THIRD PAIR, BERMUDAS; *m''*, EXTREMITY OF FOOT OF THIRD PAIR, ALBATROSS STATION NO. 2409.

It is therefore almost solely the form of the hook which distinguishes the two species, for the chela of the first pair, the telson, and the carpocerite are quite alike; this character of the dactyls is not only very marked, but perfectly constant in presence and in degree.

There is in this species, as in the preceding, an "*oxyceros*" form, in which the antennal scale equals the antennule, its lateral spine much exceeding the carpocerite. The resemblance of these two forms to *S. nilandensis* and *S. nilandensis oxyceros* Coutière, of the Maldives, is extremely close. The differentiation from *S. nilandensis*, in which the supraorbital spines are equal to the rostrum, the ventral hook of the dactyl is very strong, the supernumerary hook very dis-

tinct and spinous, is relatively easy; but in *S. nilandensis oxyceros* these last differences have entirely disappeared, the only ones persisting being the greater length of the supraorbital spines, that of the lateral spine of the basicerite, and lastly the presence of a row of five spines on the meropodite.

A large female specimen from the Bermudas of *S. hemphilli longicornis* is particularly interesting in this regard; the meropodite of the left foot of the third pair bears a well developed spine; the rest of the series is wanting; the opposite member is quite unarmed, but the suggestion arising from this circumstance is none the less instructive, as it shows to what degree the parallelism between the Indo-Pacific and the American forms may be carried. The "*oxyceros*" forms of the species *S. nilandensis* and *S. hemphilli* apparently represent the first evidences of divergence of certain species originally common to two regions; judging by the much greater number of species in the Indo-Pacific region, and also from the fact that there only are found the forms with spinulous meropodites, one might infer that that region was the center of dispersion of the group.

FIG. 21.—SYNALPHEUS HEMPHILLI LONGICORNIS. *a*, FRONTAL AND ANTENNAL REGION; *m'*, EXTREMITY OF THIRD FOOT.

S. paraneomeris Coutière possesses the same form of hook as *S. fritz-müller*i, from which it is most readily separated by having the basicerite not spinous above; on the other hand, *S. paraneomeris* is no less closely related to *S. townsendi* Coutière, the basicerite of which is unarmed above, but the dactyls of which have no ventral supernumerary prominence; so that the two groups, the NEOMERIS group and the PAULSONI group, have in these three species a very evident point of approximation.

Named for Mr. Henry Hemphill, who has added largely to the Alpheidæ in the U. S. National Museum.

Localities:

West coast of Florida, 21 to 28 fathoms: *Albatross* Station No. 2409, 2 specimens, type; *Fish Hawk* Station No. 7123, 1 specimen; *Fish Hawk* Station No. 7124, 1 specimen (type of *longicornis*.)

Bermudas, G. B. Goode, 2 specimens (*longicornis*.)

Type of *S. hemphilli*.—Cat. No. 9817, U.S.N.M.

Type of *S. hemphilli longicornis*.—Cat. No. 38395, U.S.N.M.

SYNALPHEUS NOBILII, new species.

This species is represented only by a single male specimen; I do not hesitate, however, to consider it distinct from *S. fritzmülleri*. The differences which separate the two species (comparing two specimens of the same sex and of the same size) are the following:

The carpus of the small chela is more massive, its width exceeding that of the palm (proportion 1.12 instead of 0.9, as in *S. fritzmülleri*).

The second pair is shorter and thicker, the carpus being six, instead of eight, times as long as wide. Furthermore, the first segment of the carpus is shorter than the sum of the four following.

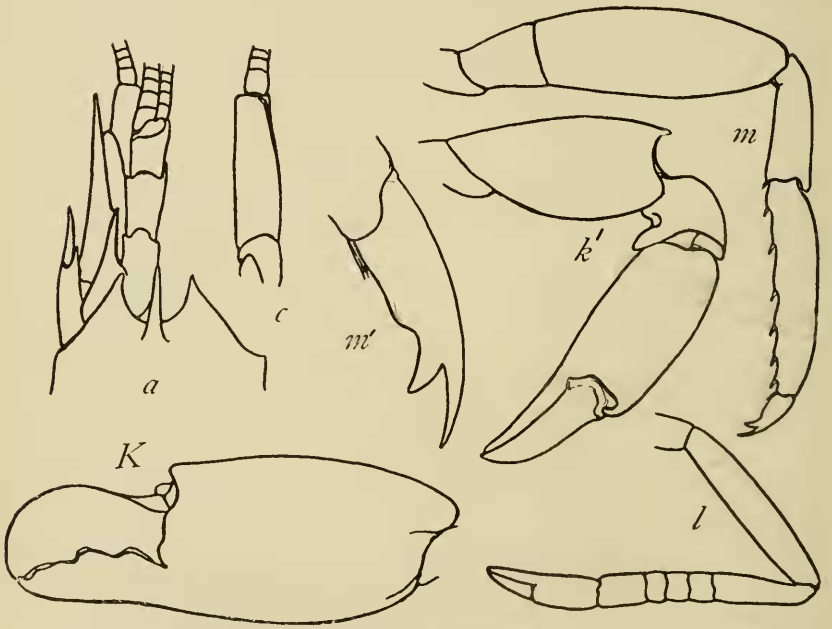

FIG. 22.—SYNALPHEUS NOBILII. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR.

The third pair is much more massive; the relative proportions being; Carpus 1; propodite 1.8; meropodite 2 (instead of 1, 2, 2.33); the meropodite is only 2.8 times as long as wide, instead of 4 times, as in *S. fritzmülleri*.

I find no other difference, either in the carpocerite, in the dactyl of the third pair, or in the telson.

Named for Dr. Joseph Nobili, the carcinologist.

Locality.—St. Helena, Ecuador, one male specimen, 25 mm. long (M. Festa; Paris Museum).

I would remind the reader that *S. fritzmülleri* is represented in the Paris Museum by a specimen from Lower California collected by

M. Diguet, which is absolutely typical and which it is impossible to separate as a distinct "race," a rare circumstance among the Synalpheids.

On the other hand, *S. nobilii* is very easily distinguished from *S. sanlucasi*, in which all the appendages, namely, the antennules, the spines of the basicerite and of the anterior margin, the large chela, the feet of the second pair, and the feet and even the dactyls of the third pair are much shorter and more massive.

SYNALPHEUS SANLUCASI, new species.

Species of each of the specific groups composing the genera *Alpheus* and *Synalpheus* are often parallel to species of closely allied

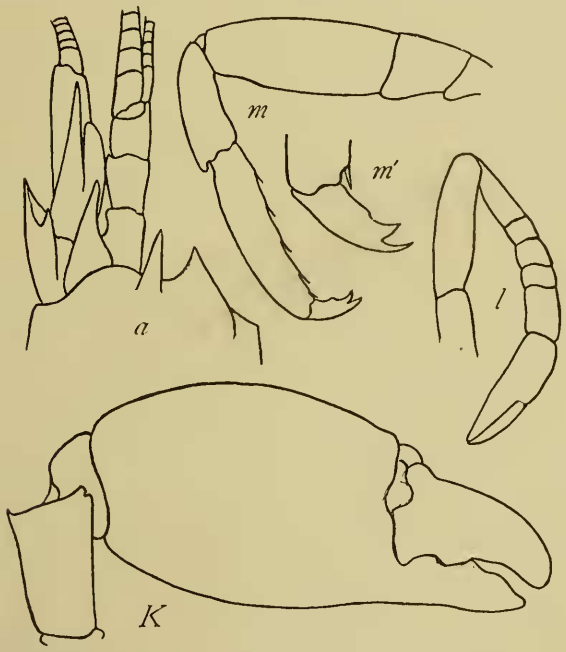

FIG. 23.—SYNALPHEUS SANLUCASI. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR.

groups in the characters upon which the separation of specific forms is based; as, for example, in the presence or absence of the superior spine of the basicerite or of the antennal scale, the slender or swollen form of the carpocerite, the spinose or unarmed palm of the large chela, and slenderness or stoutness of the thoracic feet. When one of these characters has been recognized in the species of a given group one can almost prophesy the existence of another species provided with the opposite character. This is, moreover, a well-known fact in all genera which are rather numerous in species.

Thus, *S. sanlucasi*, a form very close to *S. fritzmülleri*, differs from it in the shortness and more massive form of all its appendages.

The frontal teeth are stronger, the rostrum, especially, being wider at the base; the articles of the antennule are approximately equal, and the proportion of total length to the width is only 4.25 instead of 5, as in *S. fritzmülleri.*

The basicerite has its superior spine placed higher than in the preceding species, so that it reaches the extremity of the basal antennular article, and makes the lateral spine short and stout. Although the scale of the scaphocerite is as long as in *S. fritzmülleri*, the proportion of its length to its width is only 6 instead of 6.6, on account of its stoutness. The carpocerite is of the same form as in the preceding species, and also exceeds the antennule.

The large chela has, for its relative dimensions, fingers 1, total length 2.88, height 1.33; the small chela is lacking in the type.

In the second pair the carpus is only 5.6 times longer than wide, instead of 8, as in *S. fritzmülleri;* the relative proportions are: First article of the carpus 1; sum of the four following ones 1.6; terminal chela 1.72, very different, therefore, from the proportions found in *S. fritzmülleri;* the meropodite measures 0.7 of the length of the carpus.

The proportions of the third pair are: Meropodite 1.65; carpus 1; propodite 1.56; the meropodite is only 2.53 times longer than wide.

The dactyl has practically the same form as in *S. fritzmülleri*, the differences being that the ventral hook is wider at the base, and the entire appendage is shorter than in the preceding species.

The telson has not suffered the same diminution as the appendages, the proportions of its length to its proximal and distal ends being respectively 1.4 and 2.33, instead of 1.15 and 2, as in *S. fritzmülleri*, the telson of which species is, therefore, wider and shorter.

The eggs are of the same size as are those of the preceding species.

S. sanlucasi, readily distinguishable from the two American forms *S. fritzmülleri* and *S. hemphilli*, is much more closely allied to a species which I collected at Djibouti, and to which I give the name *S. heroni*, the species occurring on the reefs of Héron. *S. heroni* is distinguished by the following points: The lateral spine of the basicerite slightly exceeds the extremity of the median antennular article, and the antennal scale is more reduced, the proportion of its dimensions being about 7.3; on the other hand, its lateral spine, as in the "*oxyceros*" forms of many species, considerably exceeds the carpocerite.

The proportions of the large chela are: Fingers 1; length 3.2; height 1.32, it being, therefore, less massive than that of *S. sanlucasi.*

The small chela has these proportions: Fingers 1; total length 2.6; height 1.08; it is 2.45 times smaller than the large chela; the meropodite is a little more than twice as long as wide. Compared to that of S. *fritzmülleri*, the small chela appears much stouter, and it would probably be the same with *S. sanlucasi*.

In the second pair, the first article of the carpus, the sum of the four following ones, and the terminal chela are practically of the same length; the carpus is 6.5 times longer than wide.

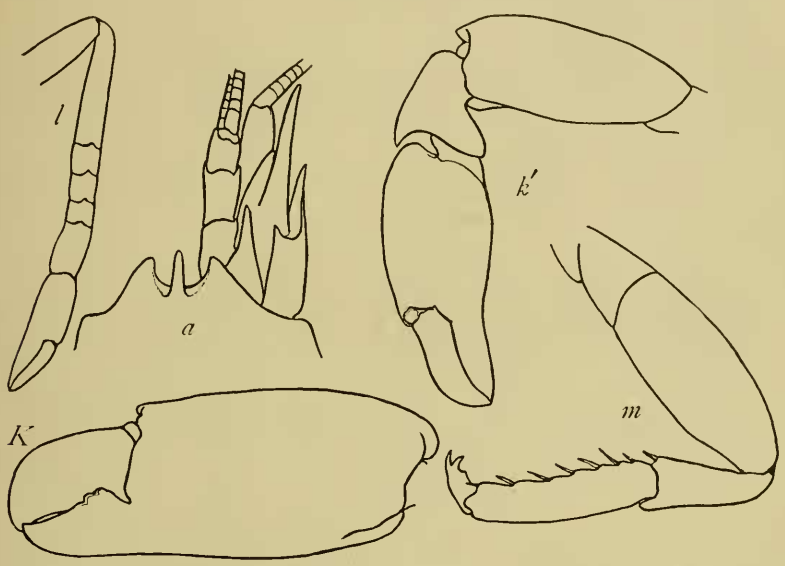

FIG. 24.—SYNALPHEUS HERONI. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR.

The proportions of the third pair are: Meropodite 2; carpus 1; propodite 1.6; the meropodite is 2.5 to 2.6 times longer than wide, and is therefore longer and thicker than in the species from Lower California.

Cape St. Lucas, Lower California; John Xantus; type, Cat. No. 6355, U.S.N.M.

BREVICARPUS Group.

SYNALPHEUS MINUS (Say).

Alpheus minus SAY, Journ. Acad. Nat. Sci. Phila., I, 1818, p. 245.

Teeth of the frontal border in the form of an equilateral triangle, the rostral tooth usually a little wider at the base, and sometimes very slightly longer, than the lateral teeth.

The proportions of the antennular articles are: 2, 1.5, 1; the relation of the total length of the stalk of the antennule to its width is 4.8 to 5; the stylocerite reaches the distal third of the median article; the external flagellum bifurcates only at the tenth article.

Basicerite of the antennæ distinctly spinous above, the spine always longer than wide at the base; the lateral spine reaches to the extremity of the basal article of the antennule.

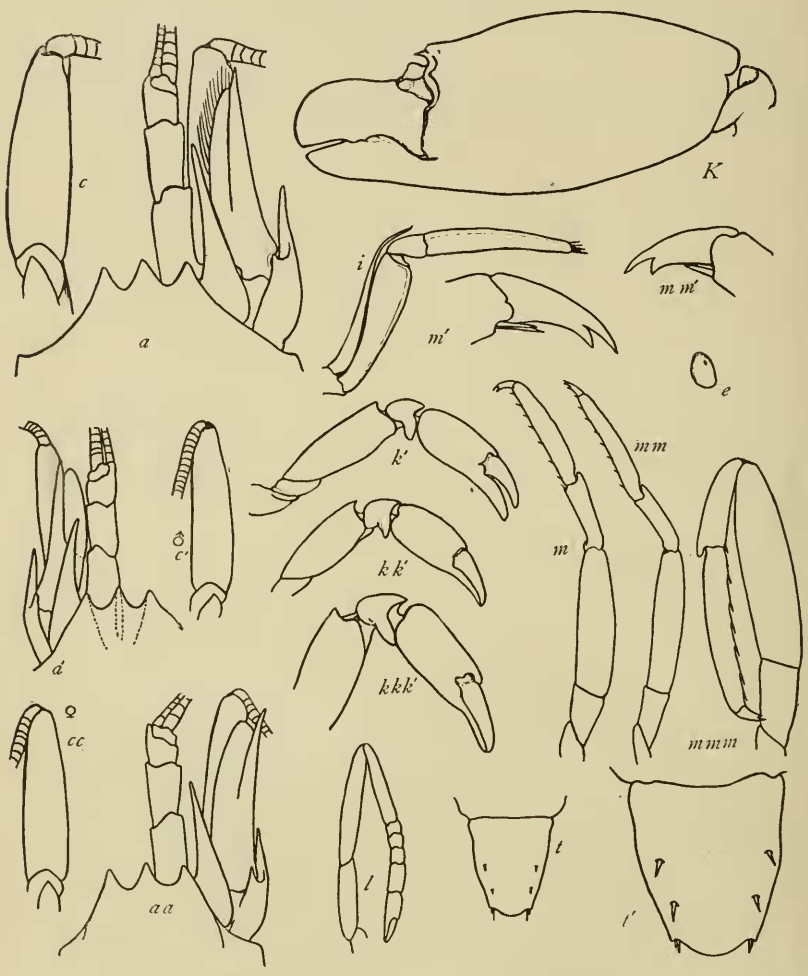

FIG. 25.—SYNALPHEUS MINUS. *a*, FRONTAL AND ANTENNAL REGION, TYPICAL; *a'*, FRONTAL AND ANTENNAL REGION, SPECIMEN FROM BERMUDAS WITH BASICERITE SPINOUS ABOVE; *aa*, FRONTAL AND ANTENNAL REGION, SPECIMEN FROM STATION NO. 7123 WITH CARPOCERITE MORE SLENDER; *c*, CARPOCERITE, TYPICAL; *c'*, CARPOCERITE, MALE, STATION NO. 7123; *cc*, CARPOCERITE, FEMALE, STATION NO. 7123; *e*, EGG; *i*, OUTER MAXILLIPED; *K*, LARGE CHELA, TYPICAL; *k'*, SMALL CHELIPED OF FIRST PAIR, S. BREVICARPUS; *kk'*, SMALL CHELIPED OF FIRST PAIR, TYPICAL; *kkk'*, SMALL CHELIPED OF FIRST PAIR, TYPICAL (ANOTHER SPECIMEN); *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR, TYPICAL; *mm*, FOOT OF THIRD PAIR, S. BREVICARPUS; *mmm*, FOOT OF THIRD PAIR, STATION NO. 7123; *m'*, DACTYL OF THIRD PAIR, NOT TYPICAL; *mm'*, DACTYL OF THIRD PAIR, TYPICAL; *t*, TELSON, S. BREVICARPUS; *t'*, TELSON, TYPICAL.

The antennal scale is narrow (proportion of length to width 7, and up to 8.5), its inner border making a very obtuse angle and not a regular curve; the lateral spine is a little longer than the peduncle of

the antennule, shorter than the carpocerite, which last is a little depressed, the proportion of its length to its width being about 3.7; it exceeds the antennule by half or even two-thirds of the distal article.

The large chela is regularly ovoid; its measurements, taken along the infero-external side, are: Fingers 1, total length 3.5; height 1.35; there is on the supero-internal side, on the anterior margin of the palm, near the articulation of the finger, a strong, sharp, and rather slender spine.

The small chela is in the proportion of about 2.7 to the preceding; its relative dimensions are: Fingers 1; total length 2.25; height 0.8; the fingers terminate in a simple point; the carpus is short, scarcely a fourth of the entire cheliped; the meropodite is 2.5 times longer than wide, its superior margin terminated by a trihedral prominence, not spinous.

In the second pair the proportion between the length and width of the carpus is about 9.5; the meropodite is only 0.75 of the length of the carpus.

The proportions of the third pair of feet are: Meropodite 2.2; carpus 1; propodite 1.6 to 1.7; the proportion between the length and the width of the meropodite is approximately 4, often a little less; the dactyl is a little curved, long, its hooks are almost parallel, the dorsal nearly twice as long as the ventral.

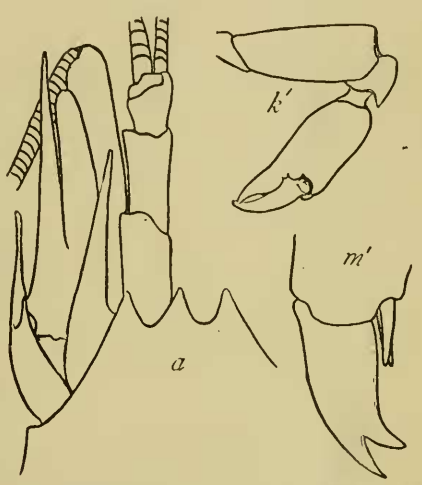

FIG. 26.—SYNALPHEUS MINUS BAHIENSIS. *a*, FRONTAL AND ANTENNAL REGION; *k'*, SMALL CHELIPED OF FIRST PAIR; *m'*, DACTYL OF THIRD PAIR.

The length of the telson equals 1.06 times the width at the base, and 1.84 times its distal margin, which is regularly convex and bears about twenty plumose hairs and two pairs of feeble spines.

The eggs are of small size (0.6 mm. in the nauplius stage, subsequently up to 1 mm.), and give rise to zoëæ.

The length of the species does not exceed 25 mm.

The typical specimens come from the region of the Bahamas and Florida, but the species extends to the Bermudas and southward to Brazil: some specimens from this last locality differ from the types and may be separated as form *bahiensis;* the basicerite of the antennæ has its lateral spine very slender, its superior spine long and strong, the lateral spine of the scaphocerite also slender, being as long as the carpocerite; the small chela is more swollen than in the typical specimens, the proportions being, fingers 1; total length 2.8; height

1 to 1.09; the proportion between the length and the width of the meropodite is 2.1 instead of 2.5; the dactyls, in the third pair especially, have their two hooks almost equally strong and long.

The strong superior spine of the basicerite, and also the greater thickness of the small chela, are found again, less marked, in some specimens from the Bermudas and from Florida, which it would be hardly advisable to separate as a distinct form. A specimen from Sarasota Bay, Florida, has an abnormal small claw, approximating the large one in its proportions; the fingers measure only one-third of the total length, and the anterior border is spinous. This tendency to the reestablishment of the symmetry of the two claws is not very rare in the Alpheidæ; and, although leading to the same results, it is diametrically opposed to the cases of hypotypic regeneration, of which also examples are known.

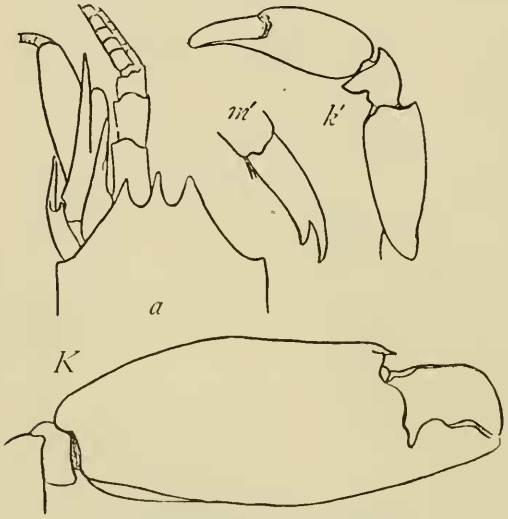

FIG. 27.—SYNALPHEUS MINUS ANTILLENSIS. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *m'*, DACTYL OF THIRD PAIR.

Other very interesting specimens differ markedly from the types by the width of the antennal scale, only 7.3 times longer than wide, recalling by its form that of *S. brevicarpus*. Other characters of the species are in these specimens weakened in the same way; for example, the carpocerite is a little less swollen, the proportion of its length to its width (3.7) declining to 4 in the male; of the members of the second pair the carpus is 10 times longer than wide. On the other hand, the dorsally strongly spinous basicerite, the thick meropodite of the third pair, the telson widened at its distal end, and the form of the chelæ of the first pair, permit the determination of these examples as *S. minus*. They indicate in what way the variation giving rise to the species *brevicarpus* is accomplished.

Among the other varieties of *S. minus*, it seems to me possible to separate a form *antillensis*. The specimens which are referred to this form come mainly from Porto Rico and St. Thomas. They differ from the types in the frontal teeth, which are long and narrow, especially the rostrum, and in the antennule, which is only 4.2 to 4.3

times as long as wide; the basicerite is not more spinous above than in the typical specimens; the carpocerite is longer, surpassing the antennules by the length of the distal article, and, especially, more ovoid (proportion 3.2 or even 3.15); the antennal scale is also a little wider than in the types; the small chela, as in the form *bahiensis*, is more swollen than in the types; it has, as its proportions, fingers 1; total length 2.38; height 0.9; there are no differences either in the form of the large chela, of the members of the second and third pairs, or in the telson.

In some specimens, especially among those from St. Thomas, the dactyls of the third pair are very slender, with the superior margin only slightly convex, and the superior hook strong. I have not a sufficient series to enable me to judge of the importance of this character.

The specimens of the form *antillensis* are all of small size, 15 mm. in length at the most. The eggs are as in the typical specimens.

Localities:

South Carolina, 15 miles southeast of Charleston, in fragment of madrepore, R. E. Earll.

Florida:

Cape Florida, Edward Palmer.

Elliotts Key, lat. 26° 33′ N., long. 83° 10′ W., 28 fathoms, *Fish Hawk* Station No. 7123 (specimen approaching *brevicarpus*).

Harbor Key.

Salt Pond Key, Stock Island.

Eastern Dry Rock.

Key West, Union University collection.

Dry Tortugas.

Florida Bay, Edward Palmer.

Two miles west of Cape Romano, 15 to 18 feet, Lieut. J. F. Moser, U. S. N.

Marco, H. Hemphill.

Sarasota Bay (specimen with small chela anomalous), Union University collection.

Anclote (specimen approaching *brevicarpus*), Thomas Low.

Florida Banks, lat. 28° 56′ N., long. 28° 15′ W., 12 feet, Lieut. J. F. Moser, U. S. N.

St. Martins Reef, Lieut. J. F. Moser, U. S. N.

Bahamas:

Andros Island, in sponges, F. Stearns collection.

Green Cay, Geographic Society of Baltimore.

St. Thomas, 20 to 23 fathoms, *Fish Hawk* Station No. 6079 (type of form *antillensis*),

Localities—Continued:

Porto Rico (form *antillensis*):

Playa de Ponce, *Fish Hawk.*

Humacao, 9½ fathoms, *Fish Hawk* Station No. 6099.

Bermudas (specimen with basicerite very spinous), G. B. Goode.

Brazil, Plataforma, Bahia (type of form *bahiensis*), R. Rathbun, Hartt Explorations.

Type of *S. minus bahiensis.*—Cat. No. 38396, U.S.N.M.

Type of *S. minus antillensis.*—Cat. No. 38397, U.S.N.M.

SYNALPHEUS DIGUETI, new species.

This species represents the BREVICARPUS group on the coast of Lower California, where it has not previously been found. It is, consequently, a very important extension of the geographic distribution of this group, which thereby ceases to be an exception from the general rule. Just as the LEVIMANUS group possesses at least one Indo-Pacific species, it will also be found that the BREVICARPUS group has met in that region of the globe conditions inducing specific differentiation.

S. digueti is very near *S. minus* (Say); the differentiation is difficult except between adult specimens, and the more mature, the easier is the determination. The characters of the males are more decided than are those of the females. In the males the differences between *S. digueti* and *S. minus* are the following: (1) The antennule is 6 times longer than wide instead of 5 times, as in the males of corresponding size of *S. minus;* (2) the carpocerite is 3.5 times longer than wide instead of 3.7 times, and the lateral spine of the scaphocerite is a little shorter than the antennule; (3) the meropodite of the third pair of feet is 3.5 times longer than wide instead of 3.75 times.

In the females the antennule is not more than 5.8 times as long as wide, and the spine of the scaphocerite slightly exceeds the antennule, so that the tangible differences from the females of *S. minus* become almost none. However, the carpocerite is somewhat thicker, 3.54 to 3.58 times longer than wide, while this proportion reaches 3.7 to 3.75 in the females of *S. minus;* there is also a very slight difference in the thickness of the meropodite of the third pair, where the proportions are nearly 3.5 in *S. minus* and 3.3 in *S. digueti.*

There is also in both sexes a slight difference in the meropodite of the small cheliped; this is at the most as wide as the palm, and generally a little narrower in *S. minus* (proportion 0.92 to 0.96); in *S. digueti*, on the other hand, it is wider (proportion 1.1 to 1.13).

The specimens which have just been considered do not exceed 25 mm. in length; in one large female measuring 30 mm. (also collected by M. Diguet) the characters are much more clearly indicated,

the antennules especially, markedly slender, being 6 times longer than wide, as in the male; in the largest females of *S. minus*, which are of equal size, this proportion never exceeds 5; the carpocerite is only 3.35 times longer than wide instead of 3.7 times, as in the largest female of *S. minus*.

This specimen presents, moreover, a very peculiar form of rostrum, the point being shorter, and, particularly, much narrower than the lateral teeth. I have noticed in a male a tendency toward this shape. The lateral spines are very slightly longer than the rostrum, forming

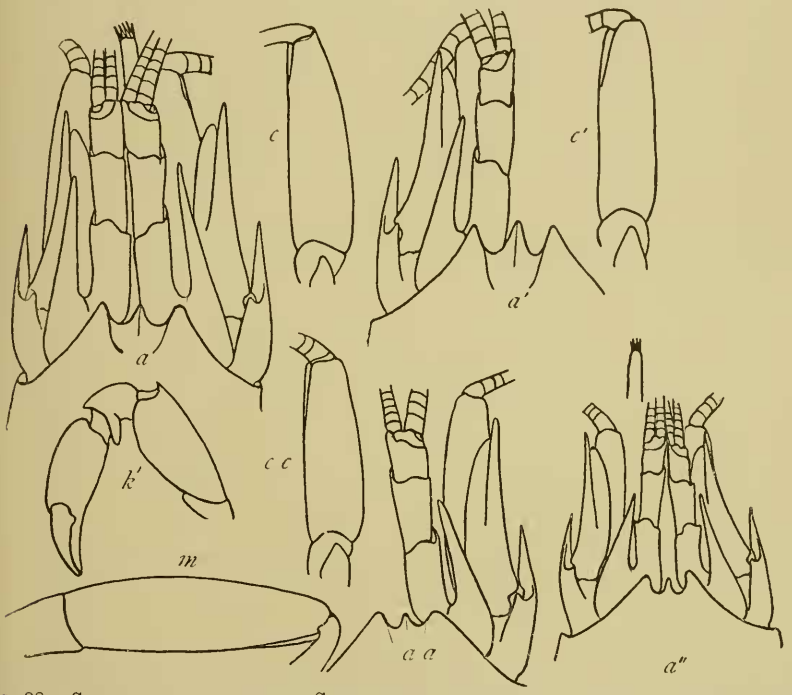

FIG. 28.—SYNALPHEUS DIGUETI AND S. DIGUETI ECUADORENSIS. *a*, FRONTAL AND ANTENNAL REGION OF S. DIGUETI, MALE OF MEDIUM SIZE; *a'*, FRONTAL AND ANTENNAL REGION OF S. DIGUETI, FEMALE OF MEDIUM SIZE; *a''*, FRONTAL AND ANTENNAL REGION OF S. DIGUETI, FEMALE OF LARGE SIZE; *aa*, FRONTAL AND ANTENNAL REGION OF S. DIGUETI ECUADORENSIS, MALE; *c*, CARPOCERITE OF S. DIGUETI, MALE; *c'*, CARPOCERITE OF S. DIGUETI, FEMALE; *cc*, CARPOCERITE OF S. DIGUETI ECUADORENSIS; *k'*, SMALL CHELIPED OF FIRST PAIR OF S. DIGUETI; *m*, MEROPODITE OF THIRD PAIR OF S. DIGUETI.

a prominence exceeding it in height, so that the rostrum seems to be situated on a lower plane.

The eggs are of the same size as those of *S. minus* and also give rise to zoëæ.

Twelve specimens, male and female, from Lower California (M. Diguet, Paris Museum).

One very interesting form of this species is represented by two specimens, male and female, from Ecuador. The differences between the

male and female are very slight; the frontal teeth are very short, and the rostrum a little shorter and weaker than the lateral teeth, especially in the male. In both cases the antennule is 5.5 times as long as wide; the lateral spine of the scaphocerite is as long as the antennule; the carpocerite exceeds it very little in the female, a little more in the male, and is very much swollen, only 3.5 times as long as wide in the male, or 3.3 times in the female; the meropodite of the third pair is 3.25 times as long as wide in both specimens.

This form of *S. diguetí* (which might be distinguished under the name of *ecuadorensis*) makes the distribution of the BREVICARPUS group much like that of the PAULSONI group, which has representatives in Lower California and Chile, in Brazil and Florida, as well as in the West Indies. I have shown in the introduction to this paper what interest attaches to the presence or absence of the species of the BREVICARPUS group elsewhere than on the American coasts, because of their close relations of kinship with the species of the PAULSONI group.

St. Helena, Ecuador; M. Festa; 2 specimens, male and female (Paris Museum).

Named for M. Diguet.

SYNALPHEUS BREVICARPUS (Herrick).

Alpheus sauleyi var. *brevicarpus* HERRICK, Mem. Nat. Acad. Sci., V, 1891, p. 383.

The species is also very like *S. minus*, from which it is distinguished by the following characters:

The proportions of the antennular articles are 1.8, 1.7, 1; the proportion of the length to the width of the antennule is at least 5.5.

The basicerite is not spinous above; it bears an angular prominence, at most as long as wide at base.

The scaphocerite has a very wide scale, with the border regularly curved within; it is from 5.5 to 6.4 times longer than wide; the hairs which border it are at least twice as long as those in *S. minus;* but, on the other hand, the lateral spine, shorter and more obtuse, does not reach the end of the antennular stalk.

The carpocerite is sensibly 4 times as long as wide and more cylindrical than in *S. minus.*

The large chela has the following relative dimensions: Fingers 1; total length 3; height about 1.15, varying to 1.2. In the large specimens the movable finger presents a second obtuse prominence between the point and the molar processes of the lower margin; the palm is less regularly ovoid than in *S. minus*, and more tapering on the proximal side.

The small chela measures a third of the preceding; the relative dimensions are: Fingers 1; total length 2.35 to 2.4; height 0.65 to

0.7 (a little narrower therefore than in *S. minus*). The meropodite is similar in the two species (proportion 2.5).

In the second pair the proportion of the length to the width of the carpus is about 12:1; furthermore, the meropodite is 0.85 of the length of the carpus.

The proportions of the feet of the third pair are the same as in *S. minus* save for the meropodites, in which the proportion between the length and the width reaches 4.25.

The length of the telson reaches from 1.06 to 1.15 times its large base, always more than twice (2.05 to 2.23 times) its small base, the article being visibly narrower than in *S. minus*.

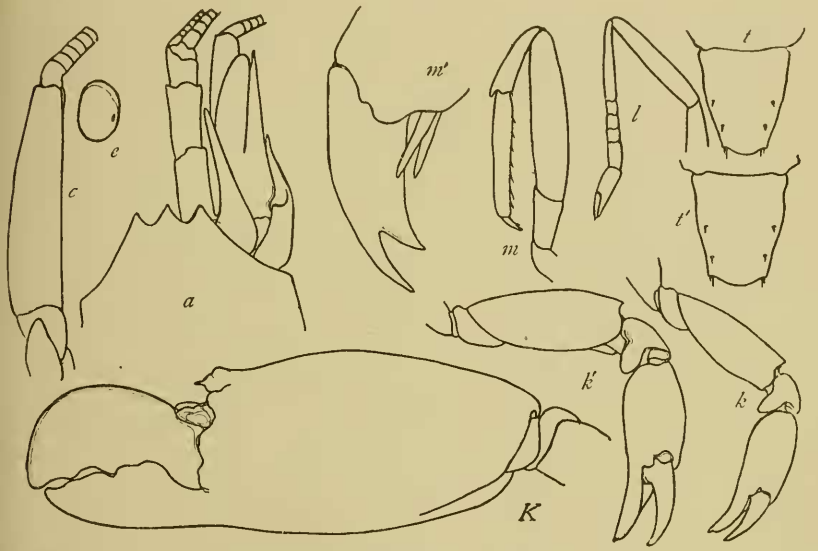

FIG. 29.—SYNALPHEUS BREVICARPUS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *e*, EGG; *K*, LARGE CHELA; *k*, SMALL CHELIPED OF FIRST PAIR, MALE; *k'*, SMALL CHELIPED OF FIRST PAIR, MALE, S. MINUS (FOR COMPARISON); *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON; *t'*, TELSON, S. MINUS (FOR COMPARISON).

The eggs are of large size and give rise to mysis larvæ provided with all their appendages, comprising the chelipeds of the first pair, which are already very unequal, and those of the second pair, in which the carpus is already segmented.

The size may reach 36 or even 38 mm. (female).

There occurs a remarkable variety of this species represented by some specimens from Key West and also from Porto Rico (*guerini*). The frontal teeth are long, especially the rostrum, which last slightly surpasses the lateral teeth and is also wider at the base; the margins are strongly concave outside instead of being straight, as in typical specimens; the basicerite of the antenna is a little more spinous

above; the scaphocerite has its lateral spine more elongate, so that it attains the length of the carpocerite.

In these characters the specimens recall the form *antillensis* of *S. minus*, but they are perfectly distinct from it; it is as if the two species, while themselves closely allied, had effected in the same way parallel variations. While in the variety *antillensis* of *S. minus* the carpocerite is ovoid, the feet of the second and third pairs are strong, and the telson is wide; in the variety *guerini* of *S. brevicarpus* the carpocerite is slender and cylindrical (proportion 1:4 and even 1:4.4), the carpus of the second pair is 12 times as long as wide, the meropodite of the third pair is 4.5 to 4.7 times as long as wide, and the telson is narrow, as in the typical specimens of the species.

FIG. 30.—SYNALPHEUS BREVICARPUS GUERINI. *a*, FRONTAL AND ANTENNAL REGION; *a'*, FRONT; *c*, CARPOCERITE.

The chelæ of the first pair are those of *S. minus*. The proportions for the small chela are: Fingers 1; total length 2.26; height 0.75.

I have been able to see the eggs on only one female of very small size, and infested with a Bopyrid; they are of the same volume as those of *S. minus*. According to the appearance of the mature ovary of another female, I think that it is their normal size, and that this is besides another character which distinguishes these specimens from *S. brevicarpus*, at the same time approaching *S. minus*.

I give to the variety the name of *guerini* because it perhaps corresponds to *Alpheus sauleyi* of Guérin. In the figure by that author[a] the rostrum is longer than the lateral spines and the basicerite appears to be spinous above. It is proper to note that in the nomenclature the trinomial appellation does not imply that this form is derived from *S. brevicarpus;* the contrary would be as plausible; the forms with large eggs, always rare, may be considered as derived from the species in which the eggs have the usual small size.

Localities:

Florida:

Elliotts Key, J. E. Benedict.

Harbor Key, Union University collection.

Key West, H. Hemphill, Bean and King, Eliot, Union University collection.

[a] Hist. Cuba de Ramon de la Sagra, Pt. 2, VII, 1857, p. 18, pl. II, fig. 8.

Localities—Continued:

Florida—Continued:

Key West (form *guerini*), Union University collection.

Dry Tortugas, Eastern Dry Rock, Salt Pond Key, and Florida Bay, Edward Palmer.

Bahamas:

Andros Island (some coming from sponges), F. Stearns collection.

Green Cay, B. A. Bean.

Porto Rico:

Off Humacao, 9½ fathoms, *Fish Hawk* Station No. 6099 (type of form *guerini*).

Type of *S. brevicarpus guerini*.—Cat. No. 24797, U.S.N.M.

LÆVIMANUS Group.

SYNALPHEUS LONGICARPUS (Herrick).

Alpheus saulcyi var. *longicarpus* HERRICK, Mem. Nat. Acad. Sci., V, 1891, p. 383 (part).

I have previously shown that this species is closely allied, not to *A. brevicarpus* Herrick, but to the European species *S. lævimanus* (Heller). However, it is not synonymous with the latter, any more than any of the forms which follow. I have indicated in the introduction to this work why it was necessary to break up into several distinct specific forms *A. saulcyi* var. *longicarpus* Herrick. I have retained the original name for the above species, as it appears to me to be the most abundant of the LÆVIMANUS group on the American coasts.

The frontal border has three unequal teeth, the median narrow, a little longer, the lateral having from 2 to 2.5 times the width of the median part of the rostrum; their interspaces are in form of a V, with borders little divergent.

The basal antennular article is the longer; its anterior margin is less emarginate on the inside than in the greater part of the species of the group. The relative lengths of the articles are 2, 1.5, 1. The antennule is 5 times as long as wide; the flagella are slender, the external bifurcates after the sixth article.

The stylocerite reaches the distal third of the basal article. The basicerite has its superior angle obtuse; its lateral spine reaches the extremity of the median article of the antennule. The scaphocerite is almost always devoid of a scale in the male; it bears one of variable length in the female, but it hardly surpasses the extremity of the basal antennular article, and it is never more than half the width of the lateral spine, which is very strong, sharp, and exceeds the antennule by about half its distal article.

The carpocerite is cylindrical, rather slender, curved outward, and surpasses the antennule by the length of the distal article; it is 5 times as long as wide, and sometimes up to 5.5 or 5.6 times.

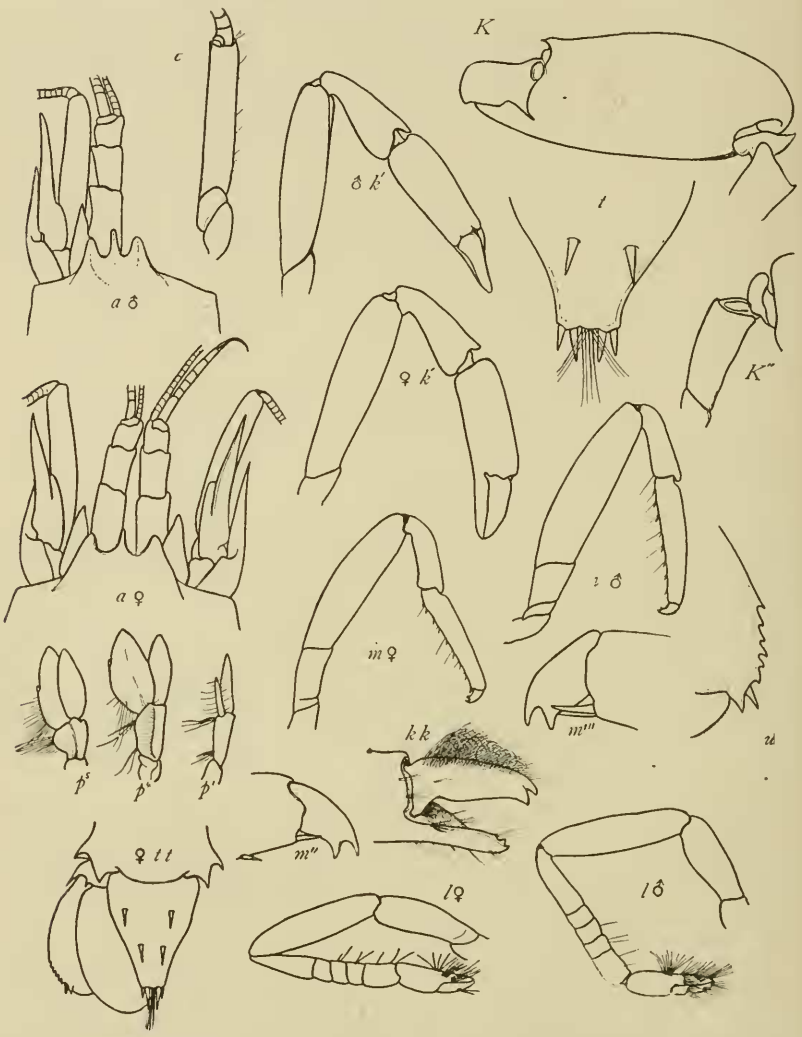

FIG. 31.—SYNALPHEUS LONGICARPUS. *a*, FRONTAL AND ANTENNAL REGION, MALE AND FEMALE; *c*, CARPOCERITE; *K*, LARGE CHELA; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *k'*, SMALL CHELIPED OF FIRST PAIR, MALE AND FEMALE; *kk*, FINGERS OF SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR, MALE AND FEMALE; *m*, FOOT OF THIRD PAIR, MALE AND FEMALE; *m''*, DACTYL OF THIRD PAIR; *m'''*, DACTYL OF THIRD PAIR OF A VERY ADULT SPECIMEN; *p'*, FIRST PLEOPOD; p^4, FOURTH PLEOPOD; p^5, FIFTH PLEOPOD; *t*, TELSON; *tt*, TELSON AND UROPODS, FEMALE; *u*, UROPOD.

The relative dimensions of the large chela are: Fingers 1; total length 4.1; height 1.5; T. L.: H. = 2.73: 1. The margin of the palm presents forward a strong tubercle, ending in a fine point. The movable finger has its point out of the perpendicular. The palm

is prolonged behind, and the very small carpus is inserted below the principal axis of the ovoid palm. The meropodite, the superior border of which ends in a right angle, is 2.25 times longer than wide. In a comparison of the male and female, the large claws are in about the proportion of 1.3 to 1.

The small claw is, to the large one, in the proportion of about 2.5 in the female, of 3 in the male, so that it is apparently of the same size in both sexes; the relative dimensions are: Fingers 1; total length 3; height about 0.8; T. L. : H.=3.75 : 1. The movable finger bears two teeth, the lower of which is the stronger; the fixed finger bears besides its point, two short angular prominences.

The carpus shows some rather remarkable variations; in the larger specimens it is constantly longer than the palm; it is usually a little shorter in medium or very small specimens of either sex. The total length of the chela being taken for a unit, the length of the carpus may vary from 0.74 to 0.56 and even 0.5; it is always shorter in the female. In every case its distal width remains equal to that of the chela. The meropodite is about 4 times as long as wide (4.4 in the male, 3.6 in the female of large size).

The second pair is notably stronger in the male (1.08), but of similar proportions in both sexes; the first segment of the carpus is shorter than the sum of the other 4 (proportion 1.2); the meropodite equals twice the first carpal segment. The terminal claw is longer, in the male, than the last 4 segments, but shorter in the female; it bears, especially in the male, about ten tufts of hair.

The third pair is also stronger in the male, where its relative dimensions are: Meropodite 2.33, carpus 1, propodite 1.7; the meropodite is 3.5 times longer than wide.

In the female these dimensions are: Meropodite 2.1, carpus 1, propodite 1.55, the meropodite being 3.8 times longer than wide. The ischiopodite is more slender and elongated also than in the male. The dactyl is short, one-sixth or more of the propodite; the two hooks are almost equal and divergent, the ventral normal to the lower border, a little thicker at the base than the dorsal, becoming proportionately longer in specimens of large size (female of 27 to 28 mm.). The sixth abdominal somite shows on either side of the telson a wide triangular point. The pleopods of the fifth somite have a very short base and a wide posterior expansion especially marked in the female, where it contributes to close the incubatory cavity. The anus is shown under the telson between two very prominent swellings. All the abdominal pleura of the male, even the second, end in a point. These last details are more marked in the LÆVIMANUS group than in any other, and especially in the two species *S. longicarpus* and *S. pectiniger*.

The telson has the following relative dimensions in the male: Small base (distal) 1; large base (proximal) 1.7; height 2.3. In the

female the large base is double the small. The posterior margin bears 4 spines, the inner a little longer, with 4 long plumose hairs between them, and 3 pairs of simple hairs inserted above the preceding. The uropods are larger in the male, the outer especially; the latter bears on its outer margin above the transverse suture a series of 7 to 8 teeth and a movable spine between the first two.

The eggs are of small size and the larvæ are zoëæ. The species may be found in sponges, but it is not probable that such is its normal habitat.

I have been able to separate among the young males a rather large number of specimens different from the type and different also from the following species, *S. goodei*, with which, however, they agree in having a well-developed antennal scale. Compared to young male *longicarpus* of the same size, they are distinguished—

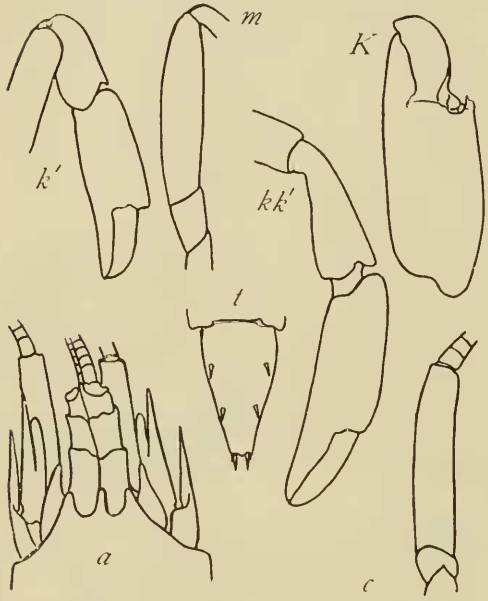

FIG. 32.—SYNALPHEUS LONGICARPUS APPROXIMA. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *k′*, SMALL CHELIPED OF FIRST PAIR OF A YOUNG SPECIMEN; *kk′*, SMALL CHELIPED OF FIRST PAIR OF AN ADULT; *m*, MEROPODITE OF THIRD FOOT; *t*, TELSON.

(1) By the antennal scale reaching the extremity of the second article of the antennule; (2) by the carpocerite a little thicker (proportions: 1:4.6, 4.9 or 5, instead of 1:5.5 or 5.6); (3) by the large chela in which the anterior border of the palm ends in an obtuse point, conical and strong; (4) by the telson a little narrower at the base; this is contained 1.8 times in the height instead of 1.4 times.

Excepting in the form and size of the antennal scale, which are quite similar, these specimens are also shown to be very distinct from the males of *S. goodei* of the same size—

(1) By the carpocerite a little thicker (the same difference as with *S. longicarpus*); (2) by the large chela, invariably shorter and thicker in *S. goodei*, even in the young, not exceeding 12 mm. in length (proportion of thickness 1.1); (3) by the small chela, of which the carpus and the palm are shorter in *S. goodei;* their sum equals only 4 times the height of the palm instead of 5 times, as in the specimens

under discussion. The meropodite is also thickened in the same proportion in *S. goodei;* (4) by the meropodites of the third pair longer and more slender (proportion 1:4.2 instead of 1:3.5).

I have met only one adult male which appears to be referable to this form; the carpus of the small cheliped measures 0.54 of the total length of the chela. It is accompanied by several other specimens, but they are too incomplete to permit of the appreciation of the fine distinctions which separate *S. goodei* and *S. longicarpus.*

I hesitate to consider this form as specifically distinct from *S. longicarpus*, although the adult specimen differs from it only by the presence of an antennal scale; this is, however, much reduced. Neither is the form of the anterior palmar tubercle very constant in *S. longicarpus*, as the small spine which terminates it may be absent. It seems to me sufficient to distinguish these specimens as form *approxima.*

Localities:

S. longicarpus—

North Carolina:

Off Cape Fear, 15 fathoms, *Albatross* Station No. 2623, 20 to 30 specimens.

Gulf of Mexico:

Lat. 27° 4′ N., long. 83° 21′ 15″ W., 26 fathoms, *Albatross* Station No. 2409, 7 specimens.

Lat. 26° 33′ N., long. 83° 10′ W., 28 fathoms, *Fish Hawk* Station No. 7123, 1 specimen.

Lat. 26° N., long. 82° 57′ 30″ W., 24 fathoms, *Albatross* Station No. 2413, 4,000 to 5,000 specimens.

Yucatan:

Off Cape Catoche, 25 fathoms, *Albatross* Station No. 2362, 20 specimens.

Off Cape Catoche, 21 fathoms, *Albatross* Station No. 2363, 15 to 20 specimens.

Jamaica, in massive black sponges, 10 to 12 fathoms, J. E. Duerden.

Curaçao, 2 specimens.

S. longicarpus approxima—

Gulf of Mexico, 26 fathoms, *Albatross* Station No. 2409, 4 specimens, type.

Gulf of Mexico, 24 fathoms, *Albatross* Station No. 2413, 2 specimens.

Gulf of Mexico, 26 fathoms, *Albatross* Station No. 2414, 4 larger specimens (mutilated).

Type of *S. longicarpus approxima.*—Cat. No. 38398, U.S.N.M.

SYNALPHEUS GOODEI, new species.

The frontal margin very forcibly suggests that of the preceding species; the rostrum is quite a little longer than the lateral spines, and the latter are more completely triangular.

The articles of the antennule have as proportions, 2.3, 1.2, 1, the antennule being 5 times as long as wide; the basicerite of the antenna has its superior angle somewhat sharp; its lateral spine reaches the extremity of the median antennular article.

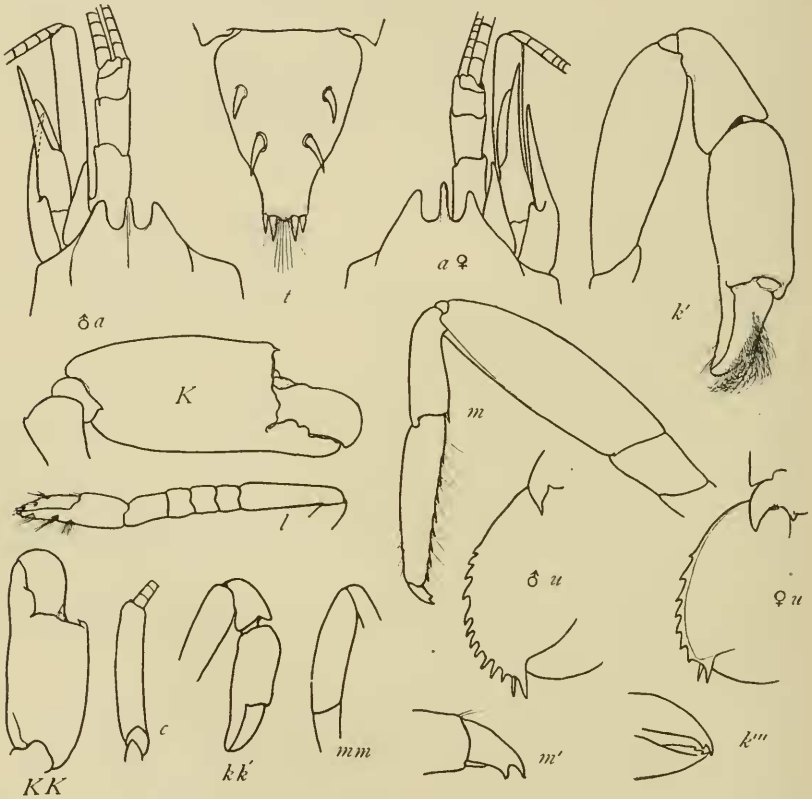

FIG. 33.—SYNALPHEUS GOODEI. *a*, FRONTAL AND ANTENNAL REGION, MALE AND FEMALE; *c*, CARPOCERITE OF A YOUNG SPECIMEN [a]; *K*, LARGE CHELA; *KK*, LARGE CHELA OF A YOUNG SPECIMEN [a]; *k'*, SMALL CHELIPED OF FIRST PAIR; *kk'*, SMALL CHELIPED OF FIRST PAIR OF A YOUNG SPECIMEN [a]; *k'''*, FINGERS OF SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *mm*, MEROPODITE OF THIRD FOOT OF A YOUNG SPECIMEN [a]; *m'*, DACTYL OF THIRD FOOT; *t*, TELSON; *u*, UROPOD, MALE AND FEMALE.

The scaphocerite always possesses a scale, which is of the same dimensions in both sexes, and often reaches the middle of the distal antennular article; the lateral spine is as in the preceding species.

The carpocerite is 5.2 times (in the young) to 5.7 to 6 times longer than wide.

[a] For comparison with *S. longicarpus approxima*, fig. 32.

The large chela has as its proportions, fingers 1; total length 3.5 to 3.6; height about 1.3; the relative total length is a little less in the female, but the difference in size is very slight; the form of the chela is quite different from that of *S. longicarpus;* the margins of the palm are nearly parallel, the anterior margin terminating in a strong tubercle which is prolonged by a point inclined downward; the carpus is inserted in the prolongation of the greater axis; the meropodite is proportionately stouter (proportion 2.05), its superior margin terminating in a prominent, not spinous, lobe.

The small chela has the following relative dimensions: Fingers 1; total length 2.8; height 0.96 to 1; the movable finger terminates in two short teeth; the carpus is always much shorter than in *S. longicarpus;* in the largest examples its length does not surpass 0.43 of the small chela, this proportion reaching 0.74 in the preceding species; in the young this proportion remains the same, while it is very variable in *S. longicarpus;* the carpus is always a little less thick than the palm, the margins of which are not parallel, as in *S. longicarpus;* the meropodite is a little more than 3 times as long as wide. I have found no sexual differences.

In the second pair, the first segment of the carpus, the sum of the four following and the terminal chela are all very nearly equal; the carpus is at least 7 times as long as wide.

The third pair has these proportions in the male: Meropodite 2.2; carpus 1; propodite 1.5 to 1.6; the meropodite is 3 to 3.2 times as long as wide; in the female these proportions become, respectively, 2.6; 1; 2; and the meropodite is nearly 3.5 times as long as wide, the entire appendage being more slender; the dactyl is short, very like that of *S. longicarpus.*

The second abdominal pleuron is not spinous in the male.

The telson has its wide base contained 1.24 times, and its small base about 4 times, in its height; the spines of the dorsal surface, especially in the male, are much stronger than those of the posterior border, the inner of which, a little the longer, include between them 4 plumose hairs and 2 groups of 3 simple hairs.

The uropods bear upon the outer border 8 teeth in the female and from 9 to 17 teeth in the male, the first and strongest of which prolongs the transverse suture; and there is also a movable spine placed between the two first teeth.

As in *S. longicarpus*, the eggs give rise to zoëæ.

The two species, which are very close to each other, are further connected through the forms which represent them on the Pacific coast. The Paris Museum possesses some specimens collected by M. Diguet in the Gulf of California, which are distinguished from *S. goodei* by the total absence of an antennal scale and by the presence of 5 to 9 teeth on the external uropod even in the male, characters

which would ally them rather to *S. longicarpus;* but they approach *S. goodei* in having the small chela thicker than in *S. longicarpus*, as

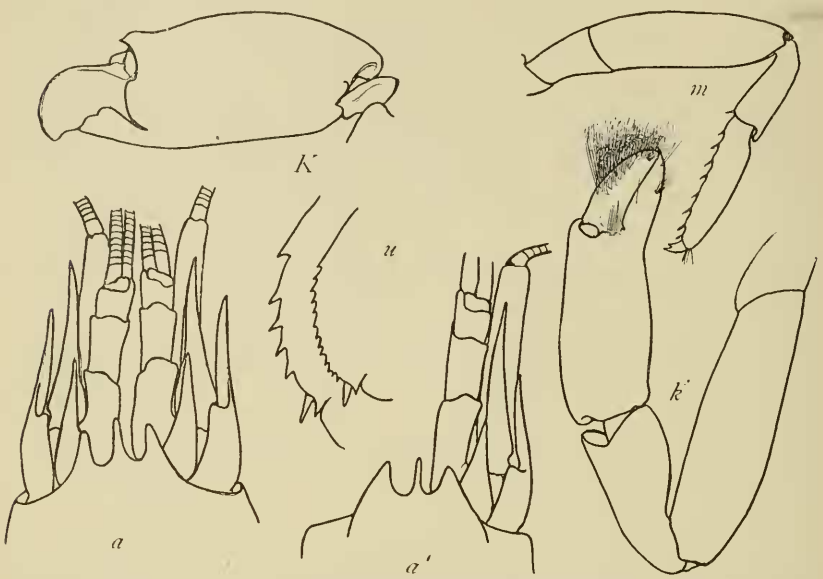

FIG. 34.—SYNALPHEUS GOODEI OCCIDENTALIS. *a*, FRONTAL AND ANTENNAL REGION; *a'*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *m*, FOOT OF THIRD PAIR; *u*, UROPODS.

is shown in the following table, and in having the meropodite of the third pair thicker:

Species.	Ratio of total length to height in small chela.	Ratio of meropodite to small chela.	Ratio of length to width in meropodite of third pair.
S. longicarpus, female	3.5–3.6	4.0	3.8
S. goodei, female	3.0	3.0	3.5
S. goodei occidentalis, female	3.2	3.5	3.3–3.4

A female is especially like *S. goodei* in possessing a rudiment of an antennal scale, a stylocerite longer than the basal antennular article, the meropodites of the third pair more similar to those of the female of *S. goodei* (proportion 3.4), and lastly 12 spines on the outer uropod, as in the male of the last-named species. I propose to designate the example from the Pacific under the name of *S. goodei occidentalis*, remarking that the female last described would probably be found to be more distinct in a more extended series.

Named for the late Dr. George Brown Goode, Assistant Secretary in Charge of the United States National Museum.

Localities:

S. goodei—

Gulf of Mexico, 34 fathoms, *Grampus* Station No. 5088, 1 specimen.

Tampa Bay, 6½ fathoms, *Fish Hawk* Station No. 7109, 1 specimen.

Near Colon, 34 fathoms, *Albatross* Station No. 2147, 1 specimen.

Bermudas, George Hawes, 2 specimens.

Bermudas, Harrington Sound, in sponges, George Hawes, 7 or 8 specimens.

Bermudas, G. Brown Goode, 20–30 specimens, type.

S. goodei occidentalis—

Lower California, Gulf of San José, M. Diguet, 7 specimens (Paris Museum).

Type of *S. goodei*.—Cat. No. 24821, U.S.N.M.

SYNALPHEUS SANCTITHOMÆ, new species.

Although very like *S. goodei*, this species ought certainly to be separated from it.

The basicerite has an obtuse superior angle; its lateral spine does not reach the extremity of the median article of the antennule; the antennal scale is 1½ times as wide as in *S. goodei*, and does not exceed the extremity of the median article of the antennule; its lateral spine is very slender, and shorter than the antennule.

The very thick carpocerite, which is 4 times as long as wide in the female, only 3.5 times in the male, is the principal distinctive character of this species.

The large chela is more slender and elongated than in *S. goodei*, especially in the female; its relative dimensions are: Fingers 1; total length 3.66; height 1.28, in the male; and respectively 1; 4; and 1.1, in the female; the upper margin of the meropodite is strongly convex and presents no prominent anterior angle.

The small chela in the male has the following proportions: Fingers 1; total length 3; height 1; the carpus measures 0.42 of the length of the chela, and the meropodite is 4 times as long as wide; in the female the proportions of the chela become 1; 2.56; 0.8.

The two chelæ are notably smaller in the female (proportions 1.15 for the large; 1.1 for the small chela).

In the second pair the first segment of the carpus is smaller than the sum of the four others, and is also smaller than the terminal chela.

The proportions of the third pair are: Meropodite 2.43; carpus 1; propodite 2; the meropodite is 4.4 times longer than wide; in the female the proportions become 3; 1; 2.15; and the meropodite is more than 5 times as long as wide.

The height of the telson is 1.47 times the width of the base and 4.7 times the posterior margin; it is consequently more elongated than in *S. goodei;* the spines of its upper surface are weak, and the inner spines of the posterior border are more than twice as long as

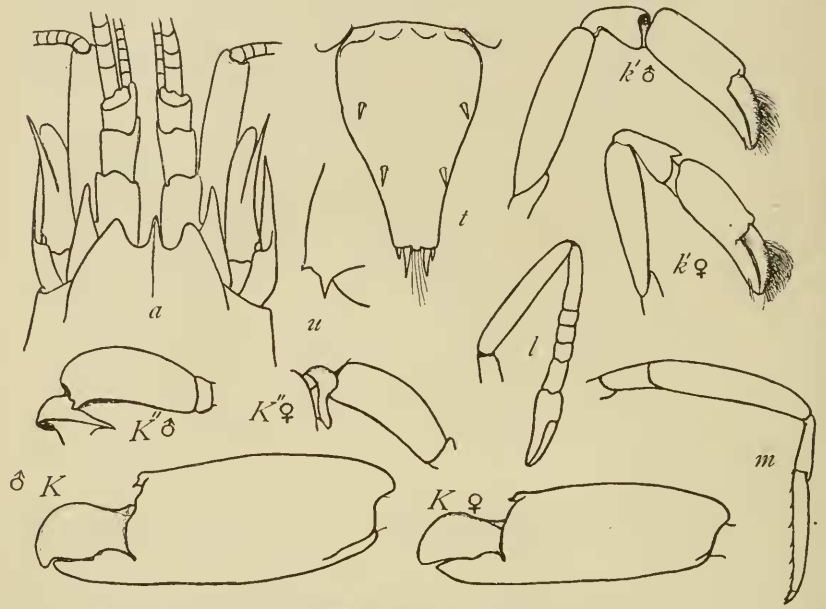

FIG. 35.—SYNALPHEUS SANCTITHOMÆ. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA, MALE AND FEMALE; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED, MALE AND FEMALE; *k'*, SMALL CHELIPED OF FIRST PAIR, MALE AND FEMALE; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *t*, TELSON; *u*, UROPOD.

the outer; the border of the outer uropod has not more than 2 fixed teeth, without an intermediate sutural spine.

The eggs give rise to zoëæ (0.8 mm. in greatest diameter).

Localities:

St. Thomas, 20 to 23 fathoms, *Fish Hawk* Station No. 6079, 1 male and 1 female of very small size (9 mm.), types.

St. Thomas, 20 fathoms, *Fish Hawk* Station No. 6080, 1 female.

Type.—Cat. No. 24782, U.S.N.M.

SYNALPHEUS GRAMPUSI, new species.

The three frontal teeth are equal in length, but the rostrum, with parallel margins, is scarcely one-fourth of the width of the lateral teeth, which are widely rounded at their extremity; the intervals between the rostrum and the lateral teeth have parallel borders, and are therefore U-shaped; the rostrum is placed at a lower level, and is continued backward by a short and narrow crest.

The segments of the antennule are to one another as 2.15, 1.3, 1; the stylocerite is a little shorter than the basal article; the basicerite has its upper angle a right angle, and its lateral spine very strong, reaching the last third of the distal segment of the antennule; it has the same width and length as that of the scaphocerite, which bears no trace of a scale in either sex; the carpocerite exceeds the antennule by the length of the distal article, and is 5.5 times longer than wide, a little concave exteriorly.

The proportions of the large chela are: Fingers 1; total length 3.3; height 1.3; it is consequently much like that of *S. goodei*, and likewise possesses a strong tubercle on the anterior margin of the palm, with a short spine directed toward the base; the meropodite has a straight, not spinous, upper margin.

FIG. 36.—SYNALPHEUS GRAMPUSI. *a*, FRONTAL AND ANTENNAL REGION, MALE; *a* ♂, ANOMALOUS SPECIMEN; *K*, LARGE CHELIPED; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR, MALE AND FEMALE; *t*, TELSON; *u*, UROPOD.

The small chela is to the large as 1 to 2.9. Its relative dimensions are: Fingers 1; total length 2.68; height 0.85 to 0.9; both fingers end in a sharp point; the carpus is 0.52 of the entire cheliped; the meropodite is 3.9 times longer than wide.

In the female these proportions become, for the large chela: Fingers 1; total length 3.3; height 1.37; and for the small chela, respectively, 1; 2.78; 0.9; the large chela is therefore a little more thick-set in the female, and the fingers of the small claw are slightly shorter.

In the second pair the first segment of the carpus equals the terminal chela, the sum of the other 4 segments being greater; the carpus is about 9 times as long as wide.

The third pair is very robust in the male. The relative dimensions are: Meropodite 2.33; carpus 1; propodite 1.6; the meropodite is only 3 times as long as wide; the dactyl has its two hooks almost equal, the ventral a little stronger.

In the female the proportions remain the same, but the dimensions of the second and third pairs are noticeably less (about 0.8).

The height of the telson is 1.2 times the width at the base, and 3.9 to 4 times the posterior margin, the last dimension as in the males; the border bears 4 equal and almost equidistant spines, including between them, on a narrow, convex portion of the margin, 5 hairs, of which 3 are large and plumose; the spines of the upper surface are longer than those of the margin.

The outer border of the uropod bears 6 to 8 spines, the first large, continuing the border of the suture, the second and following rapidly diminishing; only the last or the last two are not mobile.

The eggs give rise to zoëæ.

I have never met with any vestige of an antennal scale; on the other hand, a male (*Fish Hawk* Station No. 7124) shows an interesting variation in the length of the antennal spines, which do not reach to the extremity of the median antennular article; this specimen indicates the way in which *S. pandionis*, the next American species described, has become differentiated.

One female (*Grampus* Station No. 5116), of which all the eggs are hatched, and the zoëæ are still present under the abdomen, shows the opposite variation; both the antennal spines equal the antennule, and are also thicker than usual; the stylocerite is also a little longer.

Localities:

Gulf of Mexico:

Lat. 26° 30′ N., long. 83° 30′ W., 33 fathoms, *Grampus* Station No. 5116, a female (not quite typical).

Lat. 26° 33′ N., long. 83° 10′ W., 28 fathoms, *Fish Hawk* Station No. 7123, 1 male, 2 females, types.

Lat. 25° 50′ 15″ N., long. 82° 41′ 45″ W., 21 fathoms, *Fish Hawk* Station No. 7124, 2 males, 3 females.

Lat. 27° 04′ 00″ N., long. 83° 21′ 15″ W., 26 fathoms, *Albatross* Station No. 2409.

Type.—Cat. No. 38399, U.S.N.M.

The species is very close to the one that I described in a previous paper under the name *S. lucimanus* var. *parfaiti*, and which should also be separated as a distinct species. It is unfortunately represented by a single female, of which the small chela is missing.

The frontal teeth and the rostrum are separated by wider intervals with divergent margins; the lateral teeth are wider at the base and less obtuse at the extremity; the rostrum is on a level with them, and

is prolonged backward by a very slight, but wide, crest. The articles of the antennule are to one another as 1.8, 1, 1.

The lateral spine of the basicerite is a little longer than the antennule and also than the spine of the scaphocerite; the latter is a little narrower than the preceding, and carries a very well marked rudiment of a scale which does not, however, exceed the extremity of the basal antennular article.

The large chela has as proportions, fingers 1; total length 4; height 1.5; it is more tapering distally, and the tubercle on the margin of the palm is less prominent, bearing no spine; the superior margin of the meropodite is convex, and rounded at the distal extremity.

The small chela is missing.

FIG. 37.—SYNALPHEUS PARFAITI. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA AND CARPUS; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON; *u*, UROPOD.

In the second pair the first segment of the carpus, the four following, and the distal chela are approximately equal.

The proportions of the third pair are: Meropodite 2.28; carpus 1; propodite 1.7; the meropodite is 3 times longer than wide, as in *S. grampusi.*

The height of the telson is 1.08 times the width of the base, 2.66 times the posterior margin, which latter has its inner spines 2.5 times wider than the outer, and also much stronger; between them are six plumose hairs and two lateral groups of three simple hairs; the spines of the superior face are shorter and stronger than in *S. grampusi.*

The external margin of the uropod bears only two short teeth, with one long movable spine nearer the sutural tooth.

The larvæ are zoëæ.

The type comes from Annobon, off the west coast of Africa (Count Parfaite, Paris Museum).

Named for the collector.

Synalpheus lævimanus (Heller) of the Mediterranean is quite distinct from both of these species; the frontal margin bears three equal teeth, the rostrum being about two-thirds as wide as the lateral teeth, and in height four times its median width, or a little less.

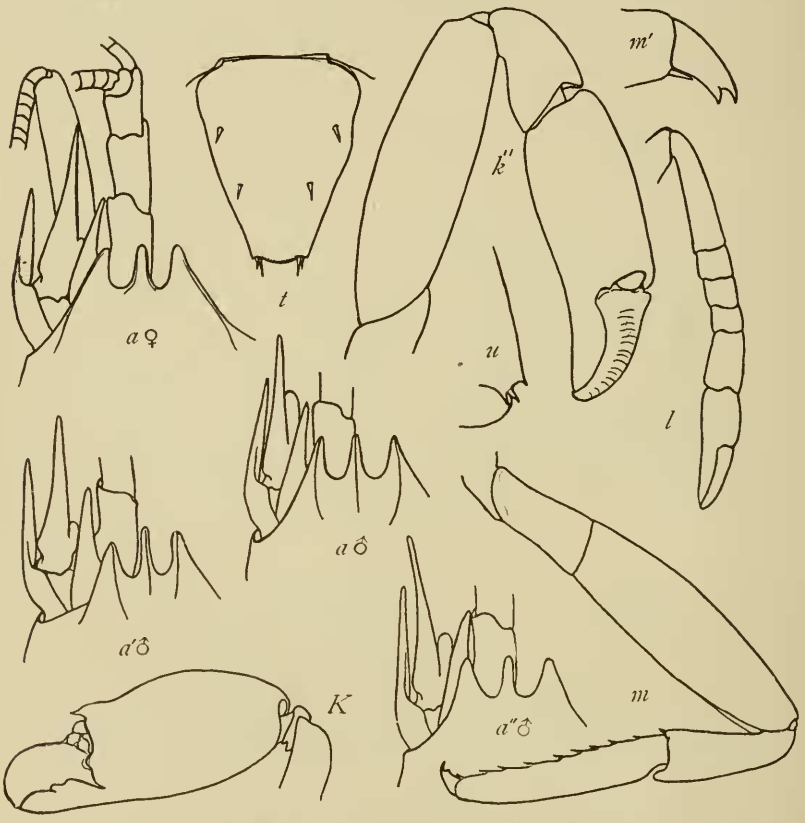

FIG. 38.—SYNALPHEUS LEVIMANUS. *a*, FRONTAL AND ANTENNAL REGION, MALE AND FEMALE; *a'*, FRONTAL AND ANTENNAL REGION, MALE WITH RUDIMENTARY SCALE; *a''*, FRONTAL AND ANTENNAL REGION, MALE INTERMEDIATE; *K*, LARGE CHELIPED; *k''*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON; *u*, UROPOD.

The articles of the antennule are to one another as 1.57, 1.07, 1; the stylocerite is narrow and equals the basal article.

The superior angle of the basicerite is obtuse, its lateral spine reaching to at least the middle of the basal antennular article; the scaphocerite is not provided with a scale in the females, where its place is only indicated by a slight prominence of the inner margin of the spine; in the males the scale is of variable length, from a very slight

rudiment to a scale reaching the proximal third of the median antennular article; its lateral spine, wider than that of the basicerite, hardly reaches beyond the middle of the distal antennular article; the carpocerite exceeds the antennule by one-half of the distal article, and is 6 times longer than wide.

The proportions of the large chela, in the male, are: Fingers 1; total length 3.4; height 1.35; the anterior margin of the palm bears a tubercle which terminates in a horizontal spine; the meropodite is rounded and unarmed on its superior margin; the proportions are the same in the female, but the palm is more tapering anteriorly.

The proportions of the small chela are: Fingers 1; total length 2.8; height 1; the carpus measures only 0.35 of the entire chela; the meropodite is 3.3 times as long as wide: the fingers terminate in a single point; the plume of hairs of the movable finger is less thick than in *S. grampusi*. In the female the small chela is only slightly narrower, the proportions being 1, 2.8, 0.92; the meropodite, with the same proportions, is also a little more slender.

In the second pair, in both sexes, the first segment of the carpus, the sum of the four following ones, and the distal chela, are nearly equal, but progressively diminish slightly in length; the carpus is 10 times longer than wide.

The proportions of the third pair are: Meropodite 2; carpus 1; propodite 1.6; the meropodite is 3.5 times longer than wide; the dactyl is short, terminating in two equal and slightly divergent hooks.

In the female the proportions are approximately the same; the height of the telson is 1.25 times its base and 3.6 times its posterior margin, which bears two pairs of feeble spines, the inner ones slightly the longer; between these are ten plumose hairs.

The external uropod bears only two feeble teeth, with a movable spine between them.

The eggs give rise to zoëæ.

SYNALPHEUS PANDIONIS, new species.

This species is distinguished from *S. grampusi* only by very slight differences, of which the principal one is the presence of a well-developed antennal scale. It is also very like *S. parfaiti*, which it approaches especially in this last character. However, I believe that these three forms are perfectly distinct. They appear to be the result of different types of variation.

The frontal teeth resemble those of *S. parfaiti*, but this is not true of the stylocerite, which is always markedly shorter than the distal article of the antennule, as in *S. grampusi:* the superior angle of the basicerite is obtuse, its lateral spine reaching the extremity of the median antennular article; the scaphocerite has in both sexes a very distinct scale, which reaches the middle of the median anten-

nular article, and is sometimes as wide as the lateral spine; the latter is equal to that of the basicerite, or is very slightly shorter; the carpocerite exceeds the antennule by 1½ times the length of the distal article; it is concave exteriorly and 6.5 times longer than wide, being, in consequence, more slender than in *S. grampusi* and *S. parfaiti*.

The proportions of the large chela are: Fingers 1; total length 3.3; height 1.3 in the male; that of the female is more stocky, the last dimension reaching 1.4; T. L.: H.=2.3:2.5. By its form, by the spine, which is directed obliquely downward, and is on the anterior border of the palm, this chela is much like that of *S. grampusi*.

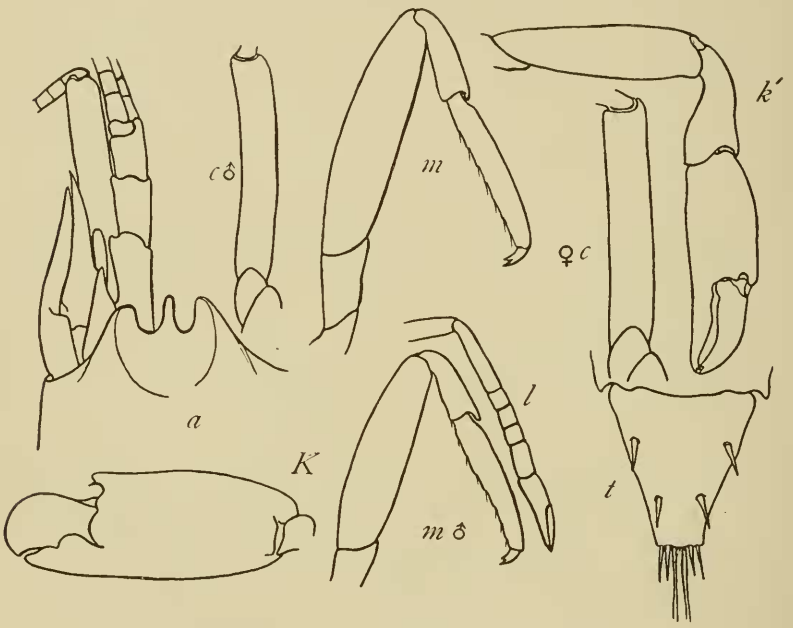

FIG. 39.—SYNALPHEUS PANDIONIS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE, MALE AND FEMALE; *K*, LARGE CHELA; *k′*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR, MALE AND FEMALE; *t*, TELSON.

The small chela is to the large as 1 to 3, in both sexes; it is consequently smaller than in specimens of *S. grampusi* of the same size; the proportions are as follows: Fingers 1; total length 2.4; height 0.72; it is therefore more slender than in *S. grampusi*.

The second pair has the same proportions as in *S. grampusi*, but it is a little more slender (proportion about 1:1.08) especially in the female.

The third pair are similar: the meropodites are equal in two specimens, one of *S. grampusi* and one of *S. pandionis*, of the same length, but the proportion of the length to the width is 3.3 in the first case, 3.8 in the second, even more pronounced in the male; in the female of *S. pandionis* this proportion is reduced to 3.7.

The telson is like that of *S. grampusi;* the outer uropod bears 4 to 6 spines.

The eggs give rise to zoëæ.

Locality: St. Thomas, 20 to 23 fathoms, *Fish Hawk* Station No. 6079; 2 males, 4 females.

Among the specimens is a female which may be considered an "*oxyceros*" form (subspecies *extentus*) of this species, as the spines of the basicerite and of the scaphocerite equal the antennule, and the antennal scale reaches the end of the median antennular article. *S. grampusi* and *S. parfaiti* are equally "*oxyceros*" relative to *S. pandionis*, which last may be considered as more primitive and less adapted to creeping or fixed life on account of the persistent antennal scale, the more feeble feet, the less armed uropods, etc.

Type of *S. pandionis*.—Cat. No. 38400, U.S.N.M.

Type of *S. pandionis extentus*.—Cat. No. 38401, U.S.N.M.

FIG. 40.—SYNALPHEUS PANDIONIS EXTENTUS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE.

SYNALPHEUS BROOKSI, new species.

This species and those following (*S. tanneri*, *S. herricki*, and *S. pectiniger*) constitute in the LÆVIMANUS group a collection of forms closely allied, of small size and often associated. In the absence of the small cheliped it is a difficult matter to separate *S. brooksi* and *S. pectiniger*, as they both show curious anomalies in the number and size of the eggs; after *S. longicarpus* (in company with which they are frequently found), they are among the most common forms.

S. brooksi has the tridentate portion of the frontal border distinct, joined to the adjacent portions by slightly concave curves; the three frontal teeth are short and equal, the rostrum narrower; the axes of the lateral teeth are divergent.

The articles of the antennule are to each other as 1.7, 1.05, 1; the stylocerite, short and wide, reaches about the middle of the basal article; the superior angle of the basicerite is very obtuse, its lateral spine reaching the middle of the median antennular article; the scaphocerite is absolutely devoid of a scale and is reduced to its lateral spine, which is more slender and very slightly longer than the preceding; the cylindrical carpocerite, a little concave externally, exceeds the antennule by three-fourths of the distal article; it is

short, only 4.5 times longer than wide (4.4 in the male, 4.6 in the female).

The sexes frequently differ in the proportionate size of the large chela, but this character is very inconstant. The most massive form, which I have observed in the males, correspond to the follow-

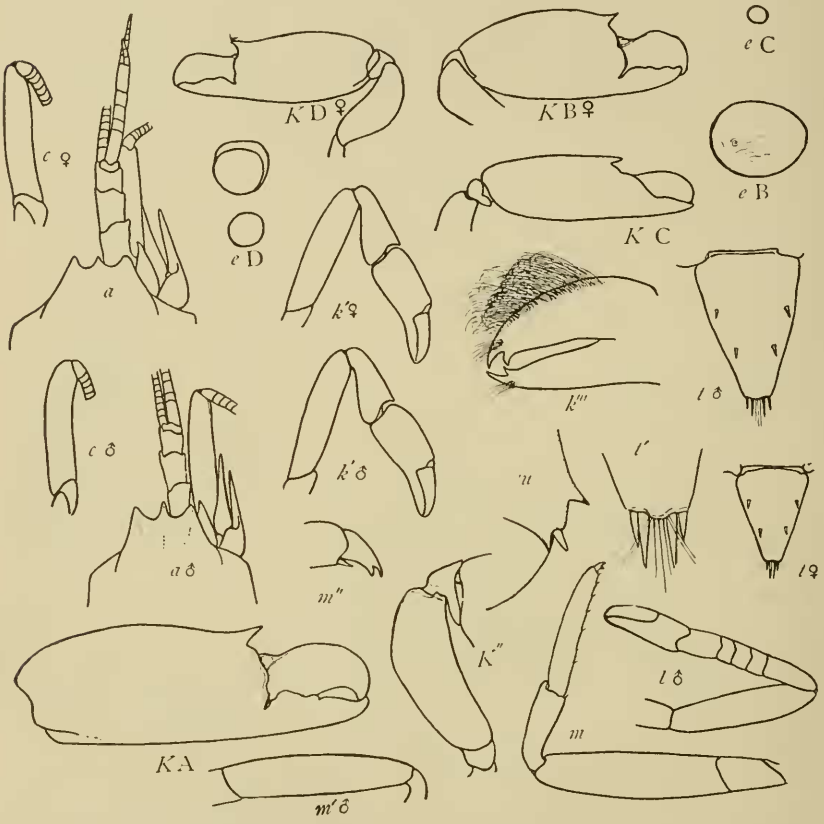

FIG. 41.—SYNALPHEUS BROOKSI. *a*, FRONTAL AND ANTENNAL REGION, MALE AND FEMALE; *c*, CARPOCERITE, MALE AND FEMALE; *e* B, EGG OF NORMAL SIZE; *e* C, EGG OF ABNORMAL SIZE FROM FEMALE, ALBATROSS STATION NO. 2362; *e* D, EGGS OF ABNORMAL SIZE FROM FEMALE, BLAKE; *K* A, LARGE CHELA; *K* B, LARGE CHELA, FEMALE, BLAKE; *K* C, LARGE CHELA, ANOMALOUS, ALBATROSS STATION NO. 2362; *K* D, LARGE CHELA, ANOMALOUS, FEMALE, BLAKE; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *k'*, SMALL CHELIPED OF FIRST PAIR, MALE AND FEMALE; *k'''*, FINGERS OF SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, MEROPODITE OF THIRD PAIR; *m''*, DACTYL OF THIRD PAIR; *t*, TELSON, MALE AND FEMALE; *t'*, EXTREMITY OF TELSON; *u*, UROPOD.

ing dimensions: Fingers 1; total length 3.43; height 1.26 (*Albatross* Station No. 2362), the proportion of the length to the height being only 2.7; but it is much more frequent to find the chela becoming more slender and this proportion equal to 2.9, 2.97, 3; the

extreme cases are those in which the proportion becomes equal to 3.25, the fingers being equal in length to the height of the palm.

In the female there are some very similar variations. I have found in a very ovigerous female (all the eggs of which were of normal volume) these proportions: Fingers 1; total length 3.6; height 1.28; the proportion L.: H. being 2.8; it is a chela which one would not know how to differentiate from that of a male, any more by its absolute dimensions than by its size in relation to that of the animal. The extreme cases are those in which the proportions become: Fingers 1; total length 2.75; height 0.9; the proportion of L.: H. then being about 3.05, and the fingers very elongate; I have met with this last form particularly among some anomalous females, carrying few eggs, very small, and probably sterile.

The most typical specimens, among those which appear to me to have been collected together, have their large chelæ very dissimilar; as an example, the proportions of a male and a female of the same size from Curacao are given below:

	Cephalo-thorax.	Large chela (total length).	Proportion $\frac{L.}{H}$	Proportion $\frac{H}{D}$	Proportion of the large chela to the cephalo-thorax.
Male (12 mm. long)..	5.0	Proportion 1.5	3.00	1.17	1.24
Female (12 mm. long)	4.6		3.29	1.05	.88

It is seen here that the male and female, as is very frequently the case in the Synalpheids, differ in the length of the abdomen, which is longer and especially stouter in the female, where the eggs distend the pleura, and also in the large chela, which is smaller and more slender in the female.

A constant character of the large chela is the presence of a conical tubercle, very prominent, and directed a little obliquely upward, which terminates the anterior border.

The small chela in the male is to the large in the proportion of 3.3 to 3.4; its relative proportions are: Fingers 1; total length 2.7 to 2.8; height 0.9 to 0.95; the fingers each terminate in two hooks; the carpus measures 0.46 to 0.5 to 0.51 of the whole chela; the meropodite is 3.6 times as long as wide.

In a female chosen from among the most normal specimens the small chela is to the large one in the proportion of about 2.3; its relative proportions are approximately the same as in the male, the carpus being, however, longer (0.5 to 0.6 of the total chela).

In the second pair the proportions of the first segment of the carpus, of the four following ones, and of the chela are 1, 1.2, 1.2; the meropodite measures 0.9 of the carpus in the female; in the male these proportions become 1, 1.4, 1.4, and the meropodite is equal to the carpus.

In the third pair the proportions are: Meropodite 2.26; carpus 1; propodite 1.62; the meropodite is no thicker in the male than in the female (proportions 4.3 to 4.5); the dactyl is short, with two teeth slightly divergent, the ventral a little stronger and shorter.

FIG. 42.—SYNALPHEUS BROOKSI STREPSICEROS. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR.

The height of the telson in the males is a little less than 4 times its posterior margin and 1.23 times its wide base; in the females this last proportion becomes 1.1; between the posterior spines, the inner of which are the longer, are found four plumose hairs, with two pairs of simple divergent hairs; the outer uropod bears only two teeth, between which is a movable spine.

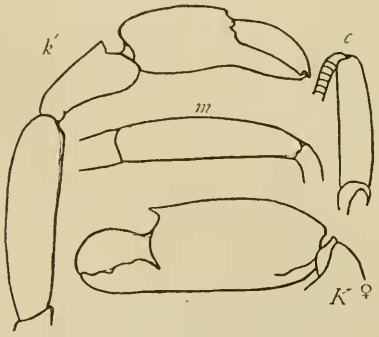

FIG. 43.—SYNALPHEUS BROOKSI ELEUTHERÆ. *c*, CARPOCERITE; *K*, LARGE CHELA, FEMALE; *k'*, SMALL CHELIPED; *m*, MEROPODITE OF THIRD PAIR.

The eggs are very large; I have counted at the most sixteen, and they give rise to very advanced mysis larvæ. When freshly laid they measure about 1.1 mm. in the long axis, and they increase to 1.6 mm. when the sixth pleosomite attains the height of the eyes in the larva folded in the egg; but females are also frequently found whose eggs do not exceed 0.5 to 0.6 mm. in the long axis; these eggs are, moreover, few (3 to 10) and have a chalky aspect in alcohol; they are probably not destined to develop. These females have in their abdominal pleura the characters of the males, as if they had been castrated by some internal parasite.

Named for the late Prof. William K. Brooks, of Johns Hopkins University.

The species presents some interesting variations. One male from St. Thomas differs from the types in certain points: (1) The spines of the scaphocerite and basicerite are longer; (2) the carpocerite is

slender, 5.5 times longer than wide; (3) the fingers of the small chela are elongated, the proportions being: Fingers 1; total length 2.38; height 0.76; proportion L.: H: = 3.12: 1; the carpus is 0.5 of the total length; the large chela is absent; the second and third pairs have their usual characters.

This specimen may be distinguished under the name of *S. brooksi strepsiceros.*

The elongation of the carpocerite in this specimen is a variation in the direction of the species *herricki.*

A second variation, bearing this time on the small chela, characterizes some specimens from the Bahamas (3 females, 5 males); the carpocerite remains short (proportion 4, 4.1), thicker even than in typical *S. brooksi;* the spines of the scaphocerite and of the carpocerite, especially of the latter, are stronger and longer than in the types; the large chela is similar in the two sexes, and even slightly thicker in the females; the proportions are those of the extreme cases met in *S. brooksi.*

	Fingers.	Total length.	Height.	Sex.	L.: H.
Form *eleutheræ*	1	3.0	1.17	Female	2.65
Do	1	3.2	1.14	Male	2.8
S. brooksi, extreme	1	3.43	1.26	do	2.7
Do	1	3.6	1.28	Female	2.8

The palm is thus shorter, while remaining as broad, in this character approaching *S. herricki;* the proportions of the small chela are: Female, fingers 1; total length 2.45; height 0.85; carpus 0.53 of the total length; male, fingers 1; total length 2.5; height 1; carpus 0.57 of the total length; the meropodite is 3.85 times as long as wide in the females, 3.8 times in the males. The males thus seem to show particularly the tendency to the lengthening of the carpus which characterizes *S. herricki,* but this lengthening is almost as marked in the females, where it is hidden by the elongation of the chela and especially of the fingers; the feet of the second and third pairs are those of *S. brooksi.*

These specimens may be named *S. brooksi eleutheræ.*

Localities:

Bahamas:

B. A. Bean, 1 specimen.

Andros Island, 1 specimen.

The Current, Eleuthera Island, B. A. Bean, 8 specimens, form *eleutheræ*, type, Cat. No. 38403, U.S.N.M.

Florida:

Harbor Key, Union University collection, 1 specimen.

Salt Pond Key, Edward Palmer, about 50 specimens.

Localities—Continued:

Florida—Continued:

Sugar Loaf Key, 50 males and females (several anomalous), including types.

Key West, H. Hemphill, 2 specimens.

Gulf of Mexico, 27 fathoms, *Albatross* Station No. 2372, 40 males and females.

Yucatan, off Cape Catoche, 25 fathoms, *Albatross* Station No. 2362, 80 males and females.

Vieques, 14 fathoms, *Fish Hawk* Station No. 6085, 1 specimen.

Vieques, 12½ fathoms, *Fish Hawk* Station No. 6095, 2 specimens.

St. Thomas, 20 to 23 fathoms, *Fish Hawk* Station No. 6079, 2 specimens.

St. Thomas, 1 specimen, form *strepsiceros*, type, Cat. No. 8936, U.S.N.M.

Brazil, off Cape St. Roque, 20 fathoms, *Albatross* Station No. 2758, 1 specimen.

Type of *S. brooksi*.—Cat. No. 38402, U. S. N. M.

SYNALPHEUS HERRICKI, new species.

The tridentate portion is distinct from the rest of the frontal margin, to which it is united by rectilinear borders; the three teeth are approximately equal in length, the rostrum a little narrower than the lateral teeth, which are at least as long as wide at the base, and usually longer.

The articles of the antennule are as 2, 1.4, 1; the stylocerite reaches the distal third of the basal article.

The superior angle of the basicerite is obtuse; its lateral spine reaches to at least the middle of the median antennular article; it is 1.5 times thicker than the spine of the scaphocerite, which bears no trace of a scale; it is usually, also, very slightly longer, but it may be only equal to it; the two spines are straight and parallel.

The large carpocerite exceeds the antennule by the length of the distal article; it is a little concave, cylindrical, 5 times as long as wide in the males, or 4.7 to 4.8 in the females.

The proportions of the large chela are very similar in the two sexes: Fingers 1; total length 3.25 to 3.4; height 1.33 to 1.35; the ratio is L.:H.=2.42 to 2.5:1; these figures apply to the males; in the females they become, respectively, 1, 3 to 3.2, 1.2 to 1.35, 2.3 to 2.5; the large chela in the female is generally proportionately broader, with the fingers a little longer; the superior margin of the meropodite is convex and unarmed; it is 2.2 times longer than wide.

In the male the proportions of the small chela are: Fingers 1; total length 2.8; height 1; the carpus is always longer than the palm, measuring 0.8 of the whole chela; the meropodite is 3.3 times longer

than wide; it is thicker than the chela (proportion 1.23), and almost as long as the carpus and the chela joined (proportion 0.79).

In the female the proportions become 1, 2.45, 0.87, the fingers being longer; the carpus measures no more than 0.67 of the whole chela; the meropodite is 3 times longer than wide, and is also thicker than the chela; it measures 0.74 of the carpus and the chela together; the size being the same, the sexual differences in the length of the chela

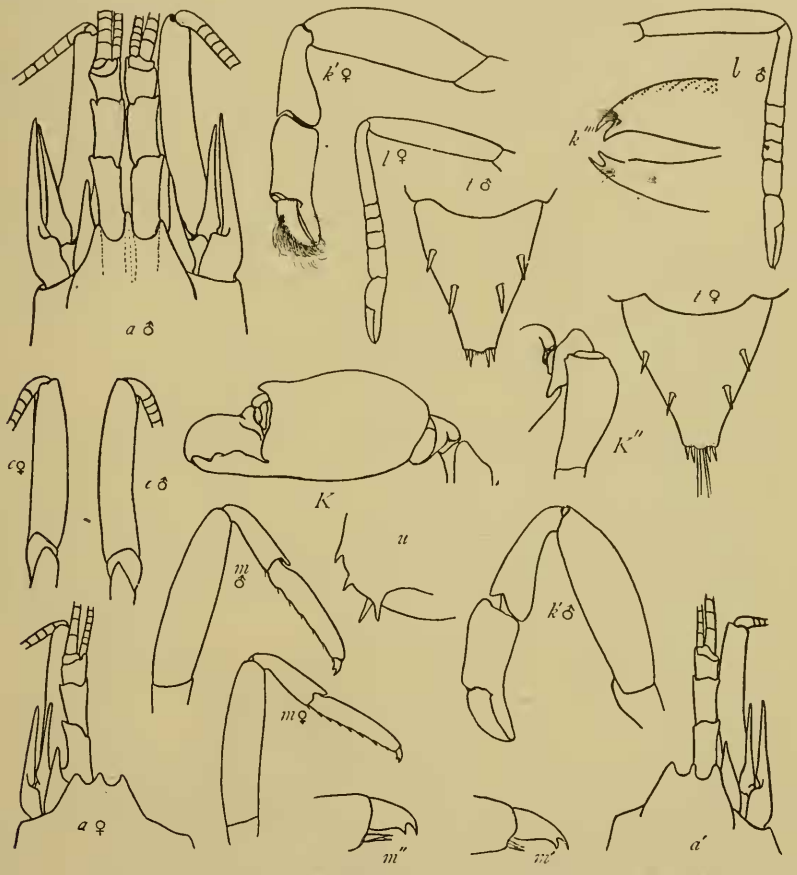

FIG. 44.—SYNALPHEUS HERRICKI. *a*, FRONTAL AND ANTENNAL REGION, MALE AND FEMALE; *a'*, FRONTAL AND ANTENNAL REGION OF ANOTHER MALE; *c*, CARPOCERITE, MALE AND FEMALE; *K*, LARGE CHELA; *K''*, CARPUS AND MEROPODITE OF LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR, MALE AND FEMALE; *k'''*, FINGERS OF SMALL CHELA OF FIRST PAIR; *l*, FOOT OF SECOND PAIR, MALE AND FEMALE; *m*, FOOT OF THIRD PAIR, MALE AND FEMALE; *m'*, DACTYL OF THIRD PAIR OF TYPICAL MALE; *m''*, DACTYL OF THIRD PAIR OF ANOTHER MALE; *t*, TELSON, MALE AND FEMALE; *u*, UROPOD.

are expressed by the proportions 1.45 for the large, 1.15 for the small chela.

In the second pair the first segment of the carpus is, in the male, a little shorter than the sum of the four others, in the female a little longer; the meropodite is a little longer in the male, the whole member being more elongated (proportion 1.2).

In the third pair the proportions are: Meropodite 2.5; carpus 1; propodite 1.55 (male); and 2.25, 1, 1.4 (female), by the shortening of the meropodite and the propodite. In both cases the meropodite is about 4 times as long as wide; the dactyl is small, tapering distally, with two slightly divergent hooks, the ventral the stronger and a little the shorter.

The height of the telson in the male is 1.6 times its base, 3.7 times its posterior margin; in the female the height equals the base, and is 4.5 times the posterior margin; in both cases the spines of the superior face are very strong, and are larger than the inner spines of the posterior margin; between the latter are four plumose hairs and two groups of four simple divergent hairs; the external uropod generally bears four teeth on its free margin, and in addition a movable spine; in the males the teeth may be three or two in number.

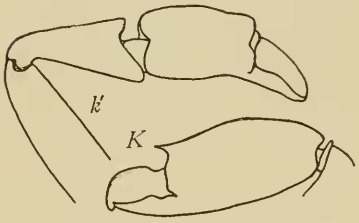

FIG. 45.—SYNALPHEUS HERRICKI ANGUSTIPES. *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR.

The eggs are of large size and give rise to mysis larvæ.

Named for Dr. Francis H. Herrick, of Adelbert College.

This species, like the preceding, shows several variations. Among the very typical specimens from *Fish Hawk* Station No. 7106 I find a female whose small chela is aberrant. In the females of *S. herricki* the meropodite and the sum of the carpus and the chela are in the proportion of 0.74; in the specimen cited this portion is 0.71, and the meropodite is more slender; the width is not, in fact, greater than that of the palm, which latter is less swollen at the base, its margins being parallel along its whole length, the proportions being T. L.: H.=3 instead of 2.6 to 2.8; the carpus is no more than 0.65 of the entire chela, and it is as wide as the palm at its distal end. In all its other characters this female (form *angustipes*) is a true *herricki;* in its small chela it approaches *S. brooksi.*

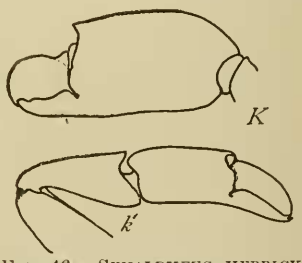

FIG. 46.—SYNALPHEUS HERRICKI DIMIDIATUS. *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR.

Six females from the same station show some differences in the same direction, but still more accentuated and not exactly comparable. The palm and carpus of the small cheliped are very typical, the latter measuring nearly 0.8 of the total chela, as in the male of *S. herricki*, and the palm being swollen at its base; the meropodite measures 0.77 of the carpus and chela together, which is also a character of the male of *S. herricki* (proportion 0.79), but it is 4 times as long as wide (in-

stead of 3.3 in the male, or 3 in the female) and its width is only 0.78 of that of the palm (instead of 1.23 in the male, 1.15 in the female, of *S. herricki*). This slenderness of the meropodite recalls *S. brooksi*. On the other hand, the large chela is equally slender, as in that last species: Fingers 1; total length 3.28: height 1.22; proportion T. L.: H. = 2.7 (1, 3.6, 1.28, 2.8 in the female of *S. brooksi*, in which the large chela resembles more that of the male). The anterior palmar tubercle also ends in a slender point.

I shall give to these last specimens the name of *S. herricki dimidiatus*.

Another variation is presented by a female from *Albatross* Station No. 2372. The rostrum is narrower and the lateral spines wider and more obtuse than in *S. herricki*. The proportions of the large chela

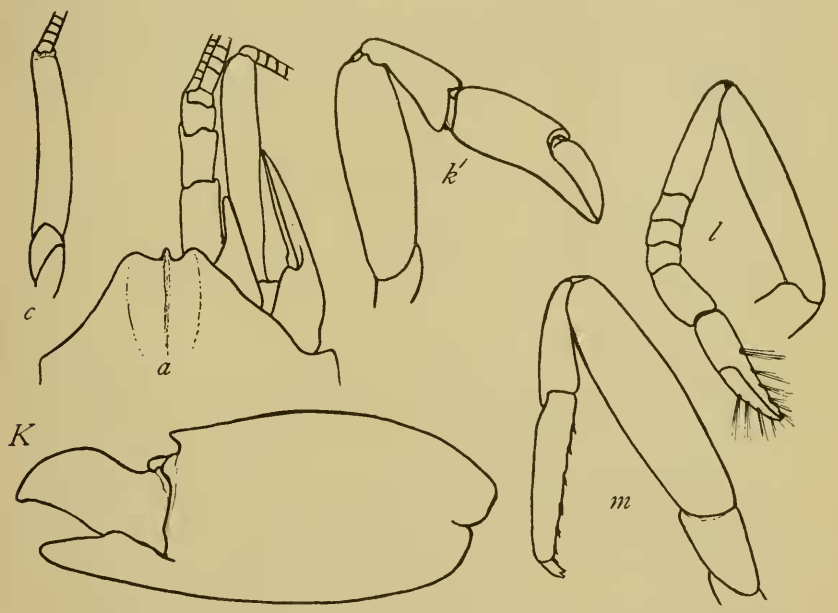

FIG. 47.—SYNALPHEUS TANNERI. *a*, FRONTAL AND ANTENNAL REGION; *c*, CARPOCERITE; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR.

are: Fingers 1; total length 3.35; height 1.39; proportion T. L.: H.= 2.4, which approaches near to *S. herricki;* the anterior palmar tubercle is very obtuse; the small chela differs from that of *S. herricki* in the short carpus, measuring only 0.56 of the whole chela: the cheliped is also more slender, the width of the meropodite being 1.2 times its ordinary width; in spite of the shortness of the carpus, the meropodite measures 0.75 of the carpus and chela together, as in the female of *herricki*, the palm of the small chela being more elongate than in the types of the species (fingers 1, total length 2.6, height 0.8, ratio T. L.: H.=3.2, instead of 1, 2.47, 0.87, 2.8 in *S. herricki* female); the feet of the second pair, rather slender in *S. herricki*,

are here very stout; compared with two specimens of almost equal size (17 mm. for *S. herricki* female; 15.5 mm. for *S. tanneri* female type), these appendages are in the ratio of 0.8 in total length and thickness; the proportion of the segments of the carpus is no longer the same, the first segment being here shorter than the sum of the four others, as in the female of *herricki;* the feet of the third pair are also stouter than in *S. herricki*, the proportions of these members being about 0.8; the relative lengths of the several segments are the same as in *S. herricki* male; there are also some differences in the dimensions of the carpocerite (ratio 5.43 instead of 4.8 in *S. herricki* female and 5 in *S. herricki* male), this being more slender than in the types, and there again approaching some proportions observed in the male.

Although unique, this specimen ought, I believe, to constitute the type of a distinct species, for which I propose the name *S. tanneri*, in honor of the late Z. L. Tanner, formerly commander of the *Albatross*.

Localities (for *S. herricki* and allies):

Anclote, Florida; Capt. Thomas Low; about 150 specimens (types of *S. herricki*).

Gulf of Mexico, lat. 25° 50′ 15″ N., long. 82° 41′ 45″ W., 21 fathoms, *Fish Hawk* Station No. 7124, 1 specimen (*S. herricki*).

Anclote Section, Florida, 12½ fathoms, *Fish Hawk* Station No. 7106, about 30 specimens (*S. herricki*).

Anclote Section, Florida, 12½ fathoms, *Fish Hawk* Station No. 7106, 6 specimens (type of form *dimidiatus*).

Anclote Section, Florida, 12½ fathoms, *Fish Hawk* Station No. 7106, 1 specimen (type of form *angustipes*).

Gulf of Mexico, lat. 29° 15′ 30″ N., long. 85° 29′ 30″ W., 27 fathoms, *Albatross* Station No. 2372, 1 specimen (type of *S. tanneri*).

Type of *S. herricki*.—Cat. No. 38404, U.S.N.M.

Type of *S. herricki dimidiatus*.—Cat. No. 38405, U.S.N.M.

Type of *S. herricki angustipes*.—Cat. No. 38406, U.S.N.M.

Type of *S. tanneri*.—Cat. No. 38407, U.S.N.M.

SYNALPHEUS PECTINIGER, new species.

While recalling the preceding species by its small size and very large eggs, this form is also closely allied to *S. longicarpus* Herrick, and may easily be confounded with small specimens of that species.

The frontal margin has three wide teeth, the median narrower in its distal half and a little longer than the lateral, but the width of the intervals separating them is always greater than their depth.

The proportions of the antennular articles are 2, 1.15, 1; the flagella are stout, the external one bifurcated after the fifth article. The stylocerite is usually a little shorter than the basal article, though often equaling it, especially in the females.

The superior angle of the basicerite is a right angle, its outer spine very strong, a little shorter than the first two articles of the anten-

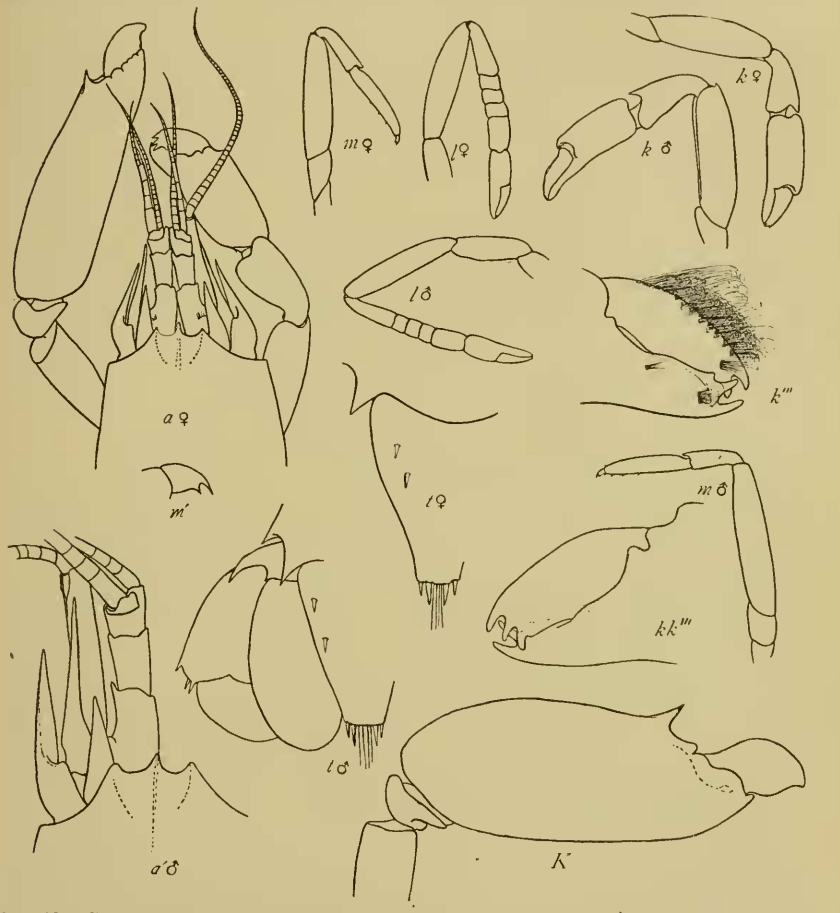

FIG. 48.—SYNALPHEUS PECTINIGER. *a*, ANTERIOR HALF, FEMALE; *a'*, FRONTAL AND ANTENNAL REGION, MALE; *K*, LARGE CHELIPED; *k*, SMALL CHELIPED OF FIRST PAIR, MALE AND FEMALE; *k'''*, FINGERS OF SMALL CHELIPED OF FIRST PAIR; *kk'''*, REVERSE OF SAME; *l*, FOOT OF SECOND PAIR, MALE AND FEMALE; *m*, FOOT OF THIRD PAIR, MALE AND FEMALE; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON, MALE AND FEMALE.

nule. The scaphocerite is absolutely without scale in both sexes; the lateral spine which alone represents it has a concave inner margin, and does not even present at its base a convex prominence marking the place of the absent scale; this spine, at least in its distal half, is more slender than that of the basicerite, in contrast to *S. longi-*

carpus; it is also shorter than the antennule, especially in the females, while in *S. longicarpus* it is always longer.

The carpocerite surpasses the antennule by two-thirds or only one-half of the distal article; it is cylindrical, a little concave on the outside, and 6.8 times as long as wide.

In the males the proportions of the large chela are: Movable finger 1; total length 3.5; height 1.2. The anterior margin of the palm bears a strong, sharp-pointed, conical prominence directed obliquely upward. The movable finger is out of the perpendicular for at least half of its length, the inferior margin of the palm rising abruptly in the place of the fixed finger, which is unprovided with any point and serves only to receive in its cavity the inferior processes of the opposing finger.

In the females, with the same general form, the large chela is much more slender, its proportions becoming: Movable finger 1; total length 5; height 1.3. The superior margin of the meropodite is a little convex, terminating in a right angle.

The proportion of the large chelæ in the two sexes is about 1: 1.7.

In the male the proportions of the small chela are: Fingers 1; total length 2.58; height 0.88. The carpus measures 0.62 of the total length. The meropodite is 3.8 times longer than wide.

In the female the proportions become 1, 3.2, 1.1, the fingers being shorter. The carpus measures only 0.56 of the total length, and the meropodite is 3.3 times longer than wide. The proportion of the small chelæ in the two sexes is hardly 1: 1.06.

This appendage is quite characteristic of the species: In both sexes each of the fingers is terminated by a plate divided into three curved and obtuse teeth; on the movable finger, which appears truncated, the teeth are equal and more and more inclined downward; on the fixed finger the innermost tooth is reduced to an obtuse prominence. As the teeth cross each other when the chela is closed, they constitute an effective implement for dividing the prey.

The proportions of the second pair are: First segment of the carpus 1; sum of the four following 1.3; chela 1.15. The proportions are the same in the two sexes, the entire member being more robust in the female. The meropodite measures 0.9 of the carpus.

The proportions of the third pair are: Meropodite 2.5; carpus 1; propodite 1.64. The meropodite is 4.3 times longer than wide. In the female these proportions become 2.2, 1, 1.5, and the meropodite is a little less thick (4.1). The dactyl has two hooks directed in the same plane as the inferior border, at least in the case of the dorsal hook, which is longer and stronger than the ventral.

All the abdominal pleura, in the male, terminate in a strong triangular point; even the second and the sixth pleosomite are prolonged in two strong spines on both sides of the base of the telson.

The height of the telson, in the male, is 1.24 times its base and 5 times its posterior margin; in the female, the height hardly exceeds the base, and is 3.7 times the posterior margin. In the female, the spines of the superior face are situated on the proximal third; in the male, on the proximal half. Between the inner spines of the posterior margin, which are twice as long as the outer spines, there are three plumose hairs.

The external uropod bears two teeth on its margin, and near the inner tooth a movable spine which is longer in the female. The basal spine of the uropod is strong and curved.

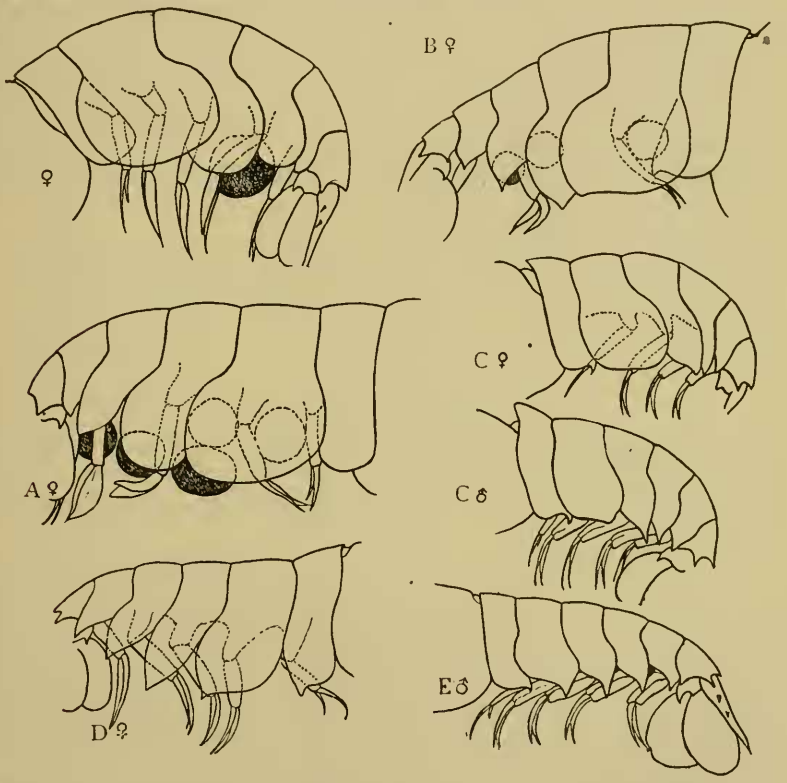

FIG. 49.—SYNALPHEUS PECTINIGER, ABDOMEN. ♀ NORMAL; A ♀, B ♀, C ♀, D ♀, DIFFERENT DEGREES OF VARIATION IN THE FORM OF THE PLEURA; C ♂, NORMAL; E ♂, ABNORMAL.

The eggs are very large and give rise to mysis larvæ. I have mentioned above that this species at an overstocked station (*Albatross* Station No. 2413, 320 males, 230 females) presents a considerable excess of males with a marked sterility of the females, as if the latter were more or less completely castrated. All the females have the fourth and fifth abdominal pleura ending in a sharp point, as in the males; all, save two have the first pleuron spinous; in the very great majority of the females, even when ovigerous, the second and third

pleura also have an obtuse point. In some cases the sex is difficult to determine, as all the pleura are strongly spinous; one can arrive at it, however, to a very great degree of approximation, by noting that the third pleuron in the males is abruptly terminated in a long point, while in the female specimens, even those most doubtful as to sex, this point is wide and arched.

The species appears very homogeneous and I have not been able to separate any variety from the typical specimens.

Localities:

Gulf of Mexico, lat. 26° N., long. 82° 57′ 30″ W., 24 fathoms, *Albatross* Station No. 2413, 320 males, 230 females (with *S. longicarpus*).

Gulf of Mexico, lat. 25° 04′ 30″ N., long. 82° 59′ 15″ W., 26 fathoms, *Albatross* Station No. 2414, 1 specimen.

Florida, Sugar Loaf Key, 4 specimens.

Bahamas, Eleuthera Island, 2 specimens, male and female (largest seen, 12 and 13 mm).

St. Thomas, West Indies, 2 specimens.

Curaçao, *Albatross*, 126 males, 167 females, types.

Curaçao, *Albatross*, 2 specimens (Cat. No. 7595).

Type.—Cat. No. 38408, U.S.N.M.

SYNALPHEUS ANDROSI, new species.

This species is represented by a single female. The frontal margin bears 3 equal, obtuse teeth, the rostrum a little less thick than the lateral teeth; the tridentate region is distinct from the rest of the frontal border.

Antennular articles as 1.7, 1.15, 1. Stylocerite wide, shorter than the basal article. Superior angle of the basicerite straight, lateral spine reaching the middle of the median antennular article. The scaphocerite is reduced to its lateral spine, which is as long as the antennule, and a little wider than the spine of the basicerite. The carpocerite surpasses the antennule by more than the length of the distal article, and is 7 times as long as wide.

The proportions of the large chela are: Fingers 1: total length 3.4; height 1.4; it is regularly ovoid and the anterior palmar border bears only a weak conical prominence. The meropodite is unarmed on its superior border.

The small chela measures: Fingers 1; total length 2.56; height 1.2; it is consequently short and thick. The movable finger is terminated by only one sharp point; it is strongly curved, stout at its base, and bears an obtuse tubercle at the middle of its lower margin. The carpus measures 0.47 of the whole chela; it is less thick than the palm, both measured at the distal extremity (0.73). The small claw and the large one have nearly the ratio of 1 to 2.

In the second pair the first segment of the carpus, the sum of the four following, and the distal chela are apparently of the same length.

The third pair is very characteristic of the species. Like the small chela of *S. pectiniger*, its form is, so far as known, unique in the genus *Synalpheus*. Its proportions are: Meropodite 1.75; carpus 1; propodite 0.92. The meropodite is 3 times as long as wide; its ventral border is widened in the distal half into a flattened surface, which is a little excavated, and margined on the outer side by a transparent wing, on the inner side by a crest much less visible, but bearing some short, strong hairs.

The very elongate carpus, also flattened on the ventral side, is likewise bordered by an outer wing larger than that of the meropodite and capable of concealing it. On the inner side, the crest which borders it bears 5 teeth and some hairs. The propodite itself has upon nearly all its length a crest which seems to be determined by the pressure of that article against the lower border of the meropodite

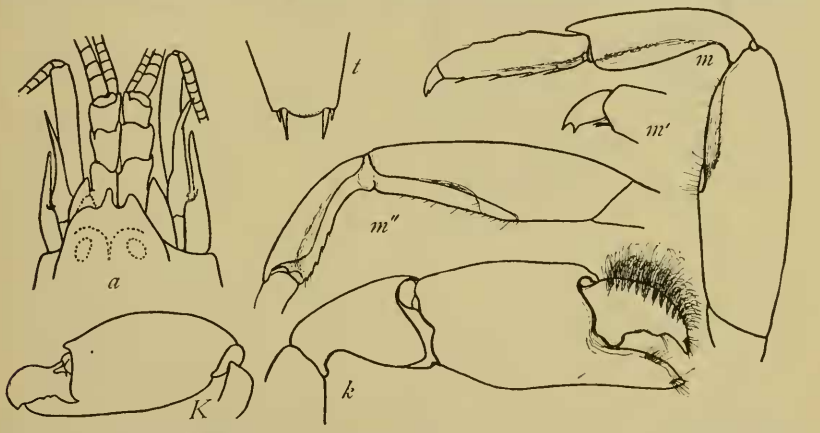

FIG. 50.—SYNALPHEUS ANDROSI. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *k*, SMALL CHELIPED OF FIRST PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *m''*, CARPUS AND MEROPODITE OF THIRD PAIR; *t*, TELSON.

when the leg is fully bent. In this position—which explains why the form of the carpus is more curved than is customary near its articulation—the distal end of this article is applied against a short non-excavate portion of the flattened meral surface, so that between it and the surface of the carpus there exists an interval closed outwardly by the two transparent superimposed plates. There exists in some species of *Alpheus* of the "*crinitus*" group, such as *A. paralcyone*, a form somewhat analogous but much less accentuated. The two hooks of the dactyl are almost equal and a little divergent.

The telson bears on its posterior border 11 plumose hairs between the inner spines, which are 3 times as long as the outer spines. The external ramus of the uropod bears a small movable spine between two adjacent teeth.

The type is a female from Andros Island, Bahamas; F. Stearns collection (Cat. No. 38409, U.S.N.M.).

SYNALPHEUS RATHBUNÆ, new species.

The frontal margin suggests *S. goodei;* the rostrum is narrow, with parallel margins, hardly one-sixth of the width of the lateral teeth and slightly longer; the lateral teeth have almost exactly the form, inverted, of the intervals between them and the rostrum, but a little narrower.

The articles of the antennule are to one another as 1.2, 1, 1; they are a little wider at the distal extremity and the flagella are stout; the stylocerite reaches the distal third of the basal article.

The superior angle of the basicerite is prolonged in a strong spine reaching as far forward as the stylocerite. This is the only case that

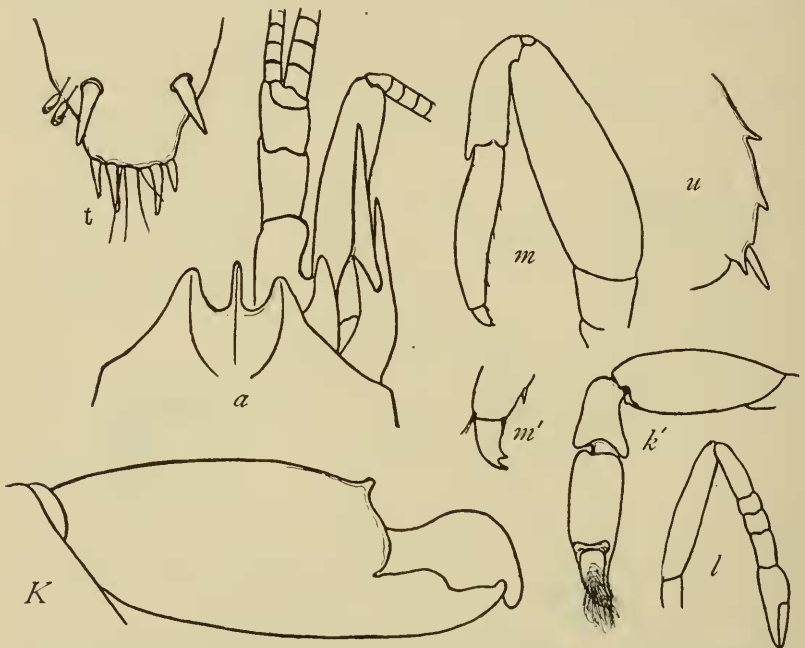

FIG. 51.—SYNALPHEUS RATHBUNÆ. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON; *u*, UROPOD.

I have as yet noticed in the LÆVIMANUS group, so that this detail enables one to identify the species immediately. The outer spine, rather slender, reaches the middle of the distal antennular article.

The scaphocerite is reduced to its lateral spine, which has a concave inner margin, is much wider than the spine of the basicerite, and reaches the middle of the distal antennular article. The carpocerite surpasses the antennule by hardly one-half of the same article; it is 4.6 to 4.8 times longer than wide.

The proportions of the large chela are: Fingers 1; total length 3.5; height 1.25. But I have also found in one of the few specimens car-

rying eggs the proportions 1, 3, 1.2. The palm bears in front a conical tubercle, not spinose, pointing obliquely upward. The movable finger slightly exceeds the fixed finger.

The small chela measures: Fingers 1; total length 2.6; height 0.95. The fingers terminate in a single point. The carpus measures 0.5 of the whole chela. The meropodite is very thick, only 2.35 times as long as wide.

The second pair is very remarkable in that the carpus has only four articles. I have encountered the same number in young specimens of *S. longicarpus*, and especially of *S. brooksi*, but very exceptionally. Here it is a constant character. It is not certain, to tell the truth, that the specimens examined are normal, at least the females. In about thirty of the specimens I have been able to find only five carrying eggs. Four of these females each possess but one egg, the fifth has only three. Their abdominal pleura are not only very slightly developed, but they are all terminated by a very sharp point, and the second pleuron is hardly wider than the first and the third. As the total length of the largest specimen is 7.5 mm., it is possible that I have had in my hands only dwarfed or emasculated individuals, not showing the true sexual characters of the species. Perhaps in specimens of larger size, if such exist, the second pair would have five segments in the carpus, as in the great majority of the Alpheidæ, the genus *Arete* (with four segments) being the only exception.

The proportions of the third pair are: Meropodite 2.2; carpus 1; propodite 1.4. The meropodite, very massive, is only 2.8 times longer than wide. The two hooks of the dactyl are parallel and equal in length, the ventral, however, the stronger.

The spines of the dorsal face of the telson are very long and strong. Between the spines of the posterior margin are four plumose hairs. The outer uropod bears three teeth and a longer movable spine very close to the first tooth.

Named for Miss Mary J. Rathbun, of the U. S. National Museum.

This species recalls especially *S. pescadorensis* Coutière, of the Malayan Archipelago; besides the exceptional character of the second pair of feet, it differs from the latter species chiefly in the plume of hairs which surmounts the finger of the small chela, as in all the species of the LÆVIMANUS group.

Localities:

Porto Rico, Mayaguez Harbor, 22 to 33 fathoms, *Fish Hawk* Station No. 6064, on dead sponges, 30 specimens, of which about 5 are females.

Vieques, 12½ fathoms, *Fish Hawk* Station No. 6095, 1 specimen.

St. Thomas, 20 to 30 fathoms, *Fish Hawk* Station No. 6079, 7 specimens, types.

Type.—Cat. No. 38410, U.S.N.M.

SYNALPHEUS PARANEPTUNUS, new species.

The tridentate region joins imperceptibly the rest of the frontal margin; the rostrum is 1.5 times longer than the lateral teeth, and of the same width; these teeth are sharp-pointed at the extremity, while the end of the rostrum is rounded.

The articles of the antennule are as 2, 1.3, 1. The stylocerite equals the basal article. The superior angle of the basicerite is a right angle, and well marked; the lateral spine reaches the middle of the median antennular article.

In the females the scaphocerite is almost wholly destitute of a scale. In the males it possesses one, which is always very narrow and in length varies between the extremity of the basal article and the

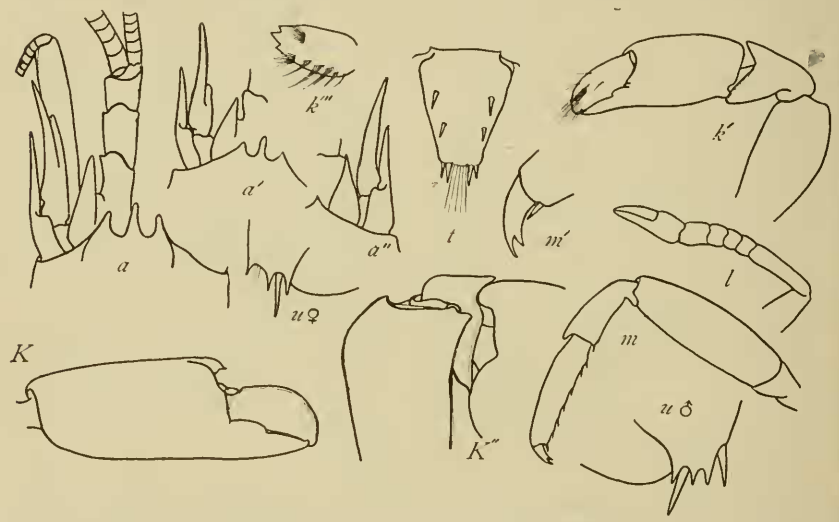

FIG. 52.—SYNALPHEUS PARANEPTUNUS. *a*, FRONTAL AND ANTENNAL REGION OF TYPE MALE; *a'*, FRONT AND BASE OF ANTENNÆ OF ANOTHER MALE WITH ANTENNAL SCALE MORE REDUCED; *a''*, FRONT AND BASE OF ANTENNÆ OF FEMALE WITH ANTENNAL SCALE ABSENT; *K*, LARGE CHELA; *K''*, MEROPODITE AND CARPUS OF LARGE CHELIPED; *k'*, SMALL CHELIPED OF FIRST PAIR; *k'''*, FINGER OF SAME; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON; *u*, UROPOD, MALE AND FEMALE.

distal third of the median antennular article. The lateral spine is considerably wider than that of the basicerite and as long as the antennule.

The carpocerite surpasses the antennular peduncle by the length of the basal article, and is 6 times as long as wide.

The proportions of the large chela are: Fingers 1; total length 3; height 1. The anterior margin of the palm bears a strong tubercle terminating in a small conical point directed downward.

The meropodite is strongly convex on its superior margin, especially near its extremity, where it forms a slight triangular prominence.

The proportions of the small chela are: Fingers 1; total length 3; height 1.17. The carpus measures only 0.4 of the entire chela. In the females these proportions become 1, 2.66, 1.06; the fingers being relatively longer, and the carpus measures 0.45 of the entire chela. The movable finger, seen from above, is oval in form and terminates in three unequal teeth, situated in the same horizontal plane; it is a little excavate below, and the lateral teeth mark the extremity of the thin and sharp lateral margins. The tuft of hairs is still present, but it is disposed in only five transverse rows, each numbering six hairs at most. This disposition is very interesting, as marking one of the extremities of the series of forms which compose the LÆVIMANUS group. In the allied species, like *S. laticeps* Coutière and *S. neptunus* Dana, the armature of hairs of the small chela either does not exist or else is very much reduced and differently disposed.

S. rathbunæ, described elsewhere, is like a second entrance into the LÆVIMANUS group through it close relations with *S. pescadorensis* and *S. biunguiculatus*. This last species may serve to designate another group of forms, almost all from the Indian Ocean and the Pacific, whence the LÆVIMANUS group seems to have sprung.

In the second pair the first segment of the carpus and the distal chela are perceptibly equal, the four other segments of the carpus slightly longer.

The proportions of the third pair are: Meropodite 2.2; carpus 1; propodite 1.5. The meropodite is a little more than 3 times as long as wide (3.1). The ischiopodite is shorter than in the other species of the group, and the dactyl is also of different form, inclining toward such forms as *S. minus;* the two margins converge slightly and the article is as if split into two parallel hooks, the dorsal a little longer.

The height of the telson equals 1.23 times its base, 2.9 times the posterior margin; the inner spines of the latter are twice as long as the outer, and between them are five plumose hairs and two pairs of simple hairs.

The outer uropod bears 3 to 4 contiguous teeth and a movable spine between the first two.

The eggs give rise to zoëæ.

The species is very close to *S. neptunus* Dana, of which I have been able to examine two typical male examples from the Sooloo Sea. The rostrum is slightly longer and narrower than the lateral spines and 4.5 times longer than its middle width. The stylocerite is shorter than the basal antennular article. The superior angle of the basicerite is slightly acute, its lateral spine reaching the proximal third of the median antennular article. The scaphocerite bears, in both cases, a very narrow scale of the same length as the outer spine

of the basicerite: the lateral spine of the scale does not reach the middle of the distal article of the antennule. The carpocerite is only a little longer than the antennule (one-half of the distal article) and is 5.3 times longer than wide.

The proportions of the large chela are: Fingers 1; total length 4.15; height 1.7. The anterior border of the palm is terminated by a strong horizontal prominence, conical and sharp-pointed. The meropodite has its superior margin unarmed; it is 2.25 times longer than wide.

The proportions of the small chela are: Fingers 1; total length 2.25; height 0.75; the fingers are almost as long as the palm. The movable finger is enlarged laterally, and bears on each margin 5 to 7

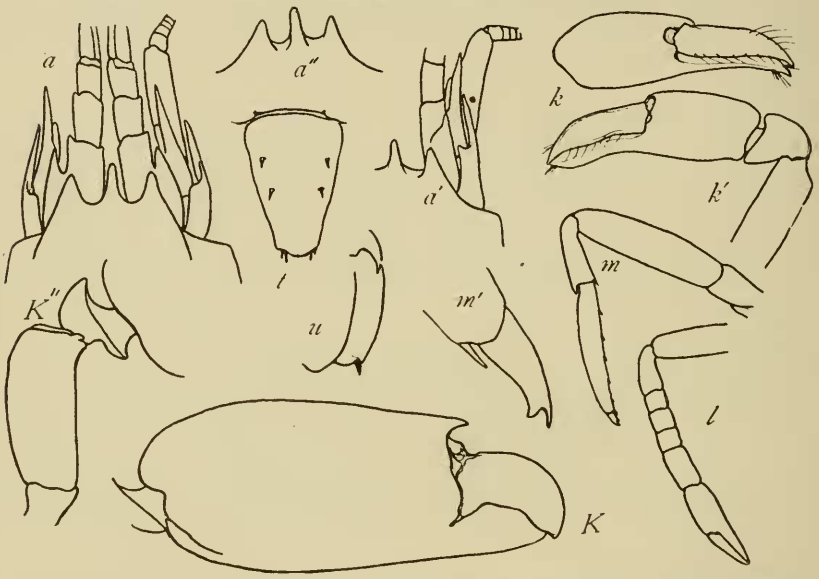

FIG. 53.—SYNALPHEUS NEPTUNUS. *a*, FRONTAL AND ANTENNAL REGION OF A TYPE MALE; *a'*, FRONTAL AND ANTENNAL REGION OF ANOTHER TYPE MALE WITH BASICERITE MORE SPINOUS; *a''*, FRONT; *K*, LARGE CHELA; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *k*, SMALL CHELA OF FIRST PAIR; *k'*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR; *t*, TELSON; *u*, UROPODS.

hairs regularly spaced, which are perhaps the first indication of the transverse series of hairs present in all of the LÆVIMANUS group. Each of these fingers is terminated by a single point. The carpus measures only 0.25 of the entire chela, a proportion which is never attained in the LÆVIMANUS. The two chelæ are in the proportion of 1 to 2.

The second pair has very peculiar proportions, the first segment of the carpus 1, the sum of the four following segments 2, distal chela 2.

The proportions of the third pair are: Meropodite 2.3; carpus 1; propodite 1.9; meropodite 4 times as long as wide. The two hooks of

the dactyl are divergent, the ventral stronger, almost perpendicular to the inferior margin.

The height of the telson equals 1.5 times its base, 3.5 times its posterior margin. The latter has two pairs of weak spines, between which the convex margin bears 7 to 8 plumose hairs. The outer uropod carries a movable spine between two teeth slightly marked.

The length of the cephalothorax is 3 mm.

Localities:

Jamaica, *Albatross*, 1884, 2 specimens.

Near Monosquillo, 42 fathoms, *Albatross* Station No. 2142, 1 specimen, type, Cat. No. 7770, U.S.N.M.

LIST OF EXTRA-AMERICAN SPECIES IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM.

SYNALPHEUS ALBATROSSI, new species.

This species, represented by only one female specimen of small size, belongs in the COMATULARUM group, which it binds to the other groups of forms in a very instructive manner.

FIG. 54.—SYNALPHEUS ALBATROSSI. *a*, FRONTAL AND ANTENNAL REGION; *K*, LARGE CHELA; *K''*, CARPUS AND MEROPODITE OF LARGE CHELIPED; *k*, SMALL CHELIPED OF FIRST PAIR; *l*, FOOT OF SECOND PAIR; *m*, FOOT OF THIRD PAIR; *m'*, DACTYL OF THIRD PAIR.

The frontal spines are large, almost equal in length and with concave borders; rostrum wider than the lateral teeth. The antennular peduncles are short and stout, the stylocerite equal to the basal article.

The basicerite bears two very short spines, the inferior a little longer, but not attaining the extremity of the frontal spines. The scale of the carpocerite is large, its lateral spine equals the carpocerite, which is 3.7 times as long as wide, and scarcely surpasses the antennules.

The distal article of the outer maxillipeds is only 3.6 times as long as wide, this proportion being 6 times in *S. minus*, for example.

The proportions of the large chela are: Fingers 1; total length 3.5; height 1.4. It tapers from behind forward, and bears a weak conical prominence on the palm, continuing the upper margin. Meropodite very thick and unarmed, only twice as long as wide.

The small chela, the carpus of which is short, has the following proportions: Fingers 1; total length 3; height 1. The fingers end in an obtuse point.

The second pair is slender, the first segment of the carpus longer than the sum of the 4 others, the distal chela small. The following feet are also slender, the meropodite being 4.5 times as long as wide. The dactyl is elongate and is terminated by two parallel hooks, the ventral a little shorter and thicker, a form which recalls the species of the PAULSONI group.

The telson is like that of the species of this group, its posterior margin being very little convex.

Laysan Island, 10 to 19 fathoms, *Albatross* Station No. 3960, 1 female, 9 mm. long, type, Cat. No. 38344, U.S.N.M.

SYNALPHEUS CHARON (Heller).

Hawaiian Islands, *Albatross* Stations Nos. 3955, 3962, and 4073.

SYNALPHEUS PARANEOMERIS Coutière.

Hawaiian Islands, *Albatross* Stations Nos. 3921, 3960.

SYNALPHEUS GRAVIERI Coutière.

Southern Japan, *Albatross* Station No. 3729.

SYNALPHEUS LÆVIMANUS (Heller).

Adriatic Sea.

SYNALPHEUS NEOMERIS de Man.

Shanghai.

DESCRIPTIONS OF NEW EXTRA-AMERICAN SPECIES MENTIONED IN THIS PAPER, BUT NOT IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM.

SYNALPHEUS MEROSPINIGER, new species.

Very near *S. neomeris* de Man, differing especially in the dactyl, the two hooks of which are almost equal. The supraorbital spines are also wider, the antennular peduncle more robust (ratio of length to

width 1 : 4.5 instead of 1 : 5 in *S. neomeris*), the stylocerite longer, and the carpocerite more slender (ratio 1 : 4.4 instead of 1 : 4).

Amirante Islands, Seychelles Group; Percy Sladen Trust Expedition.

Type in Paris Museum.

SYNALPHEUS TRIONYCHIS, new species.

Very close to *S. fossor* Paulson, differing in the carpocerite which has the proportion of 1 : 5 instead of 1 : 6, in the large cheliped spinous on the palm and the merus, in the small chela less thick than its meropodite, and in the stronger feet of the third pair; in the dactyl of this member the ventral supernumerary hook is sharp and directed forward, and the dorsal hook is almost as long as the principal hook.

Saya de Malha, western Indian Ocean; Percy Sladen Trust Expedition.

Type in Paris Museum.

SYNALPHEUS BAKERI, new species.

Allied to *S. triunguiculatus* Paulson, from which it differs in the rostrum 1.5 times as long as the lateral spines, the carpocerite stout (ratio 1 : 3.6 instead of 1 : 4.5), and shorter than the antennal spine, the palm of the large chela unarmed, and the meropodites of the two chelipeds almost unarmed. The dactyl of the third and fourth pairs is much smaller, and the ventral supernumerary hook is not one-third of the principal hook, while it is three-fourths of the same in *S. triunguiculatus*.

South Adelaide, South Australia; M. Baker, collector, for whom it is named.

Type in Paris Museum.

SYNALPHEUS PHYSOCHELES, new species.

Differs from *S. triunguiculatus* Paulson, especially in the large chela, the palm of which is very swollen and the fingers extremely short (fingers 1, total length 5.33, height 2.2). The fingers of the small chela are contained 3 times in the total length (instead of 2.7 times). The feet of the third pair are more slender, the meropodite being 4 times and the propodite 7 times longer than wide (instead of 5.5 and 3.3 times).

Djibouti, French Somaliland; Ch. Gravier.

Type in Paris Museum.

SYNALPHEUS OTIOSUS, new species.

Differs from *S. paraneomeris* Coutière in the shorter carpocerite ratio 1 : 3 instead of 1 : 4), in the unarmed meropodite of the large cheliped, that of the third pair stouter (ratio 1 : 3.5 instead of 1 : 4), the propodite of 5 spines instead of 8, the telson wider at its distal extremity (proportion of the bases 1 : 1.5 instead of 1 : 1.85).

Cœtivy Island, Seychelles Group; Percy Sladen Trust Expedition.

Type in Paris Museum.

SYNALPHEUS PAULSONI LIMINARIS, new subspecies.

Differs from *S. paulsoni* Nobili in the superior spine of the basicerite being almost wanting, in having the carpocerite a little more elongate, at least 3.5 times as long as wide (2.9 to 3.1 in *S. paulsoni*), and in having the palm of the large chela always terminated by a strong anterior spine.

Djibouti, French Somaliland; Ch. Gravier. Persian Gulf; Bonnier and Perez.

Type in Paris Museum.

SYNALPHEUS PAULSONI SENEGAMBIENSIS, new subspecies.

Differs from all the other forms of *S. paulsoni* by the more slender carpocerite (ratio 1:3.7), which approaches that of *S. hululensis*, but the superior spine of the basicerite is more slender than in that species, the posterior angles of the telson right angles and the meropodite of the small cheliped is unarmed on its superior border (the large cheliped is lacking).

Cape Verde: *Talisman*.

Type in Paris Museum.

SYNALPHEUS MUSHAENSIS, new species.

Differs from very similar forms of the PAULSONI group, by the carpocerite (proportion 1:3.6) surpassing the antennule by the whole length of the distal article of the latter; by the scaphocerite, the scale of which is wide and shorter than the antennule, while its lateral spine exceeds it very slightly; by the stylocerite not reaching beyond the inferior spine of the basicerite. The large claw has short fingers (proportions: fingers 1, total length 4.2, height 1.6), the palm bears a feeble flattened prominence on its anterior margin, the supero-external margin of the meropodite is spinous. The small claw has the following proportions: fingers 1, total length 3.12, height 1. The posterior angles of the telson are right angles except for a very slight spinous prominence ($\frac{1}{4}$ of the outer spine).

Musha Islands, Gulf of Aden; Ch. Gravier.

Type in Paris Museum.

SYNALPHEUS MACCULLOCHI, new species.

Closely allied to *S. paulsoni kurracheensis*, but differs especially in the large size of the eggs, which produce mysis larvæ, as in *S. tumidomanus* Paulson. The rostrum is narrower and longer, the spine of the basicerite much slenderer. The carpocerite has the same proportions. The palm of the large chela is unarmed. The meropodite of the third pair is 4.5 times as long as wide, instead of 4 times.

Port Jackson, New South Wales (type); A. McCulloch, for whom the species is named. South Adelaide, South Australia; H. W. Baker.

Type in Paris Museum.

SYNALPHEUS LOPHODACTYLUS, new species.

Differs from *S. biunguiculatus* Stimpson in having the basicerite unarmed above, the posterior angles of the telson spinous, and the movable finger of the small chela bearing a dorsal brush of hairs and not some lateral bunches. Furthermore, the antennular peduncles and the carpocerite are short (ratio 1:4 for both), the antennal scale is large, the feet of the third pair are slender (proportions of the meropodite 1:4.5 instead of 1:3 in *S. biunguiculatus exilipes* Coutière, which approaches it the most in this regard).

Diego Garcia, Chagos Archipelago; Percy Sladen Trust Expedition.

Type in Paris Museum.

SYNALPHEUS SLADENI, new species.

Differs from all the other species of the LÆVIMANUS group by the considerable prominence of the frontal border, the basicerite being feebly spinous below, the antennal scale large, the large chela cylindrical, almost 3.5 times as long as high, the feet of the third pair slender (proportions of the meropodite 1:5.4), and the telson very narrow with posterior right angles. It approaches the species of the COMATULARUM group, while the small chela is altogether comparable to that of *S. longicarpus*.

Cargados Carajos, western Indian Ocean; Percy Sladen Trust Expedition (to which the specific name is dedicated).

Type in Paris Museum.